NATURAL HISTORY NUMBER

SCIENTIFIC AMERICAN

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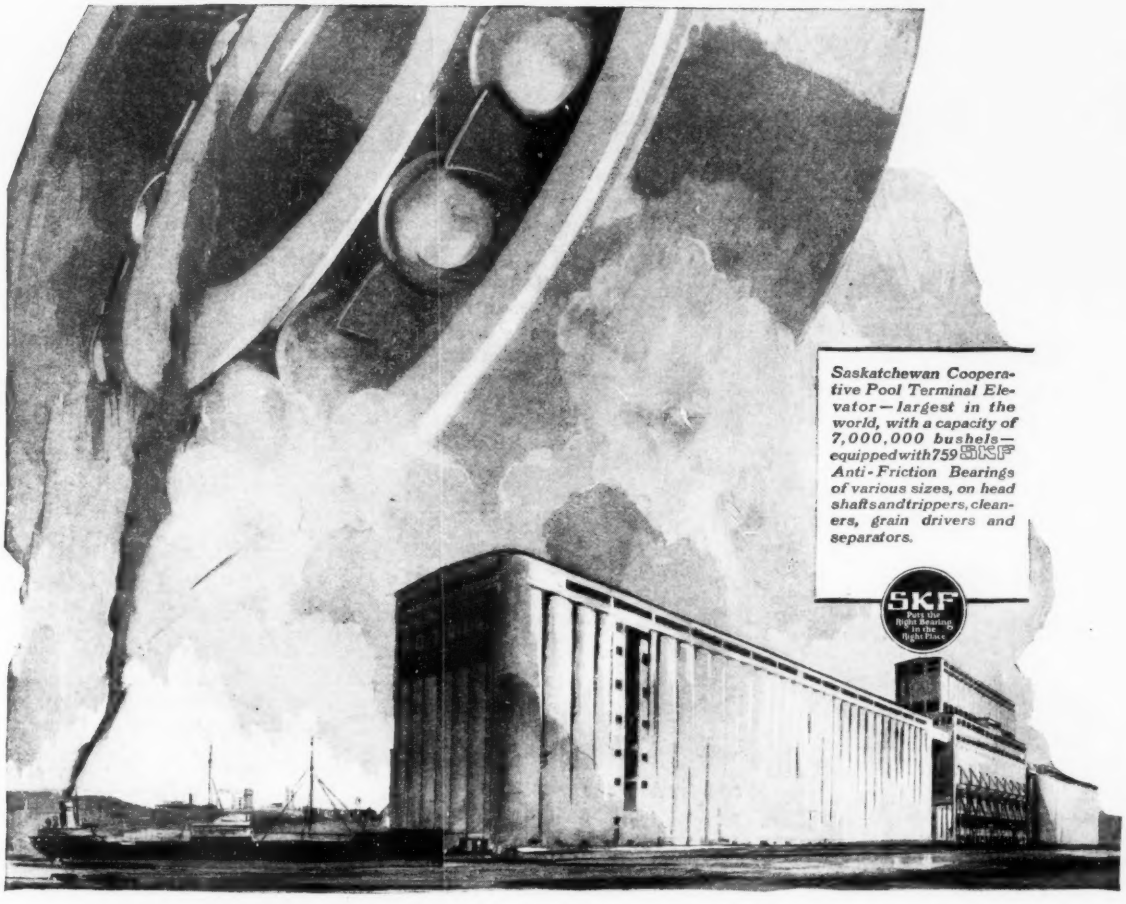

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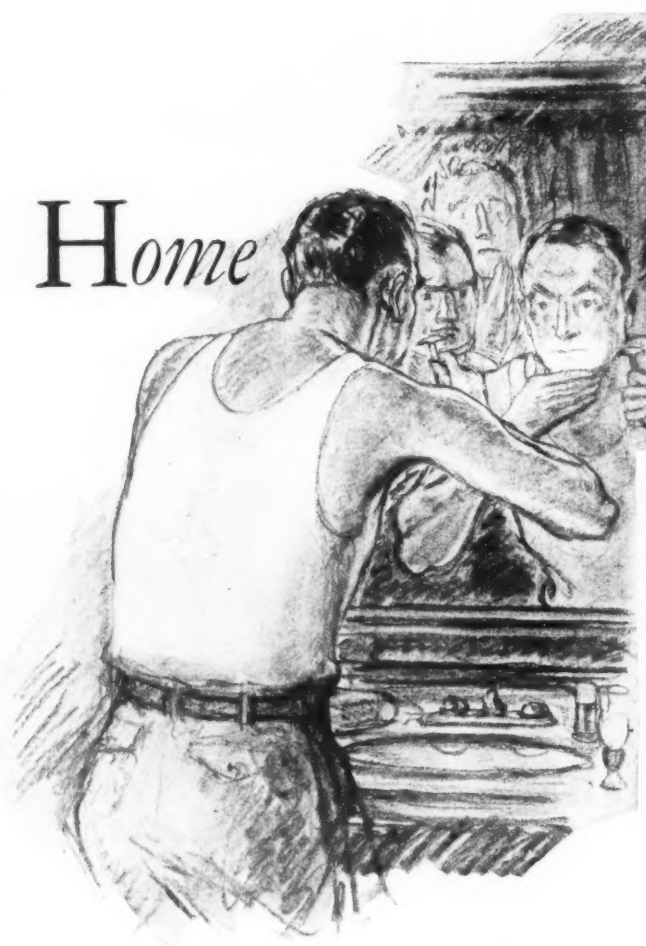

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SCIENTIFIC AMERICAN

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August 1929 — *Edited by ORSON D. MUNN* — *Eighty-fifth Year*

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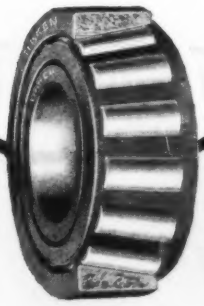
COVER

This month our artist, Howard V. Brown, has vividly shown that the camouflage artists of the war had nothing on Bill when he went after the "billies" with his camera. Completely accoutred in his "glorified nightie," even to the horns and whiskers, Bill Finley fooled the goats so well that he was able to get some good photographs of them at close range. Turn to page 140.



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TIMKEN *Tapered Roller* **BEARINGS**

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Looking Ahead *With the* Editor

Secrets of the Heavens for the Layman

INTO a dome-ceilinged room we go and, as the lights are turned out, we are enthralled by the spectacle overhead; the heavens, with every star shining clearly, meet our astonished gaze. As a lecturer talks and points out stars with a flashlight, we watch a 24-hour movement of the stars in a few minutes. An article about the planetarium which accomplishes this effect, than which no better popular instructor in astronomical lore was ever invented, is coming soon.

Steam versus Water Power

FROM the Pacific coast, stronghold of hydro-electric "interests," we have an article which explains why steam is staging a comeback and supplanting water power for the generation of electricity. It gives facts—from the source—to confirm Edison's recent pronouncement on this subject. The author is president of a large power association and a student of the power question.

Monkeyshines

TO the ears of the novice, nothing is more frightful than the roar of "howlers" challenging each other in dead of night. These red howling monkeys of South America, however, are not so dangerous as they are interesting. In a story now ready for release, many astonishing things are told of the antics, habits, and customs of "howlers," the saki, the black capauchin, the peculiar beeza, and others—by a scientist observer.

Widely Used Licorice

AS little boys, many of us prized licorice as a confection or proudly showed our teeth stained by it and pretended we were men—that we were chewing tobacco! Used since ancient times as a medicament, licorice is now used in many commercial products, one of the most interesting of which is a fire fighting agent. We have on hand an article concerning this plebeian herb and its many uses which is indeed surprising.

Advance of the War Tank

THAT fearsome monster which rumbled and grumbled across No-Man's Land and dealt death and destruction with so little danger to itself and its occupants—who would have thought it would make necessary a rebuilding of modern armies? Yet that is exactly what the tank has done. We will publish soon an article on this mechanization phase of military progress—an article that seems to prophesy a different sort of future warfare, with the super-tank.

Every Issue Fully Illustrated

¶ *The whole family will be interested in science if it is presented to them in the* SCIENTIFIC AMERICAN *manner. Keep them up-to-date in the affairs of the world by a yearly subscription. Only four dollars.*

Among Our Contributors

Walter N. Pack

MR. PACK is president of the American Nature Association. Together with Mr. Finley, who is Director of Wild Life Conservation, he has made a number of fruitful expeditions for the purpose of photographing wild life in its native haunts. They have carried their cameras to British Columbia, to the Pribiloff Islands, and twice to Glacier National Park. They are now in the southwest on a hunt for cougars—armed only with cameras.

Karl P. Schmidt

MR. SCHMIDT is Assistant Curator of the Division of Reptiles in Field Museum of Natural History. During his seven years at this museum, he has conducted much important research and has engaged in several expeditions. Highly qualified as a general zoologist, his specialties are reptiles and amphibians; he has published numerous books and papers on herpetological subjects.

R. Broom

MAN'S ancestors had for their own ancestor an early mammal which, in turn, descended from an earlier creature. That creature is now known to have been a reptile which developed mammalian characteristics. More than any other, Professor Broom has worked out that part of our family tree in which an advanced reptile evolved into a mammal. Last year he was awarded the coveted Royal Medal for his 33 years of research. His fame is world wide.

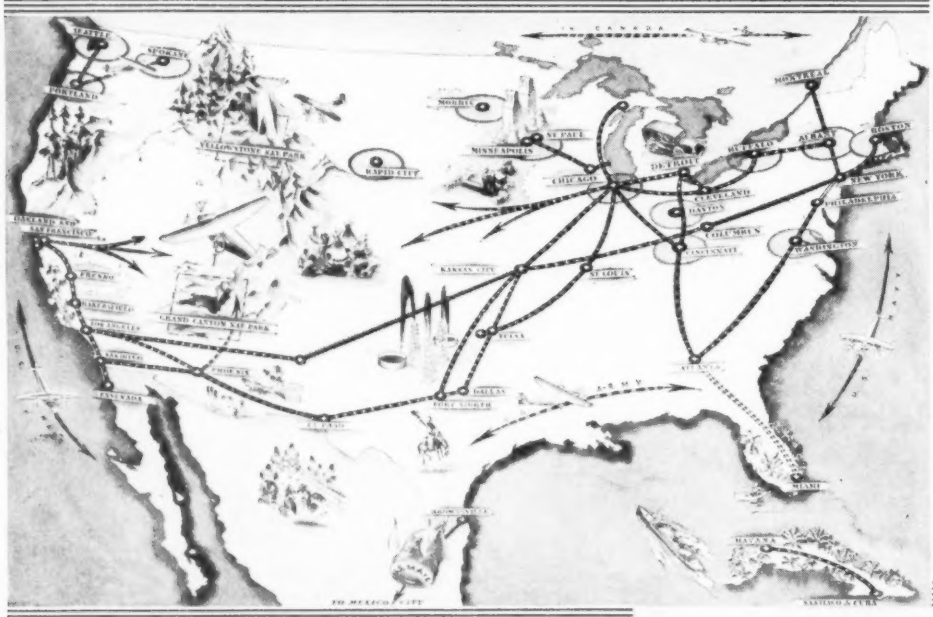
John T. Rowland

MR. ROWLAND served on American destroyers during the World War as a Lieutenant, Junior Grade. On scouting and convoy duty in British waters, he had an excellent opportunity to study blimps at first hand. His observation then, and later study, lend authority to his discussion of the commercial possibilities of the blimps.

Carl J. Lomen

ONE of the earliest pioneers in the gigantic and rapidly growing industry that has been built up around the reindeer of Alaska, Mr. Lomen is still very active in the business of raising these animals and making them available for world meat markets.

• • • WHERE FORD PLANES FLY



Features of Ford Plane

All-metal (corrugated aluminum alloys)—for strength, uniformity of material, durability, economy of maintenance, and structural safety . . .

Tri-motored (Wright or Pratt & Whitney air-cooled engines, totaling from 900 to 1275 horse-power)—reserve power for safety.

Speed range—55 to 140 m.p.h. Cruising radius, 580—650 miles.

Useful load—3670 *to* 5600 *pounds.*

High wing monoplane (single, stream-lined, cantilever wing)—for strength, speed, inherent stability, visibility, clean design . . .

12-15 *capacity* (including pilot's dual-control cabin)—Buffet, toilet, running-water, electric lights, etc.

Durability—No Ford plane has yet worn out in service.

Price, $42,000 *to* $55,000 (standard equipped)—Exceptionally low because of multiple-unit on-line production methods.

OUR AIRPLANE FACTORY at Dearborn is now producing three giant all-metal, tri-motored commercial planes a week, and will soon be producing one a day! In one year we have had to increase the capacity of our factory 400%!

A glance at the skyways where Ford planes fly gives you a comprehensive view of the whole field of commercial aviation in North America.

Maddux Air Lines employ a fleet of thirteen Ford planes in regular service between Ensenada, Mexico, Los Angeles, and San Francisco, and all important points between.

Southwest Air Fast Express will fly twelve big Ford transports linking St. Louis and Kansas City, Tulsa, Oklahoma, Dallas, Ft. Worth, and El Paso, Texas.

Transcontinental Air Transport (T-A-T) has ten Ford planes for transcontinental air-rail service between New York and the Pacific Coast.

Northwest Airways flies Ford planes regularly between Chicago and the Twin Cities.

National Air Transport operates six between New York and Chicago; Chicago and Dallas.

Pitcairn Aviation is using Ford planes for express-mail-passenger service from New York southward, paralleling the Atlantic Coast.

Colonial Airways flies Ford all-metal planes between New York and Montreal; Albany and Buffalo; New York and Boston.

Cia Mexicana de Aviacion S A, connecting Brownsville, Texas, with Mexico City, Gautemala City and Managua, Nicaragua, and Panama, uses Ford planes.

Pan-American Airways flies Ford planes from Havana to Santiago de Cuba.

Standard Oil of Indiana, Standard Oil of California, the Texas Company, Curtis Publishing Company, and Reid Murdoch Company, are among the industrial users.

U. S. Army, U. S. Navy, and Byrd Expedition are among the military and scientific users.

Ford Air Lines have flown 1,200,000 miles and carried over 7,000,000 pounds! Stout Air Services run from Detroit to Cleveland and Chicago.

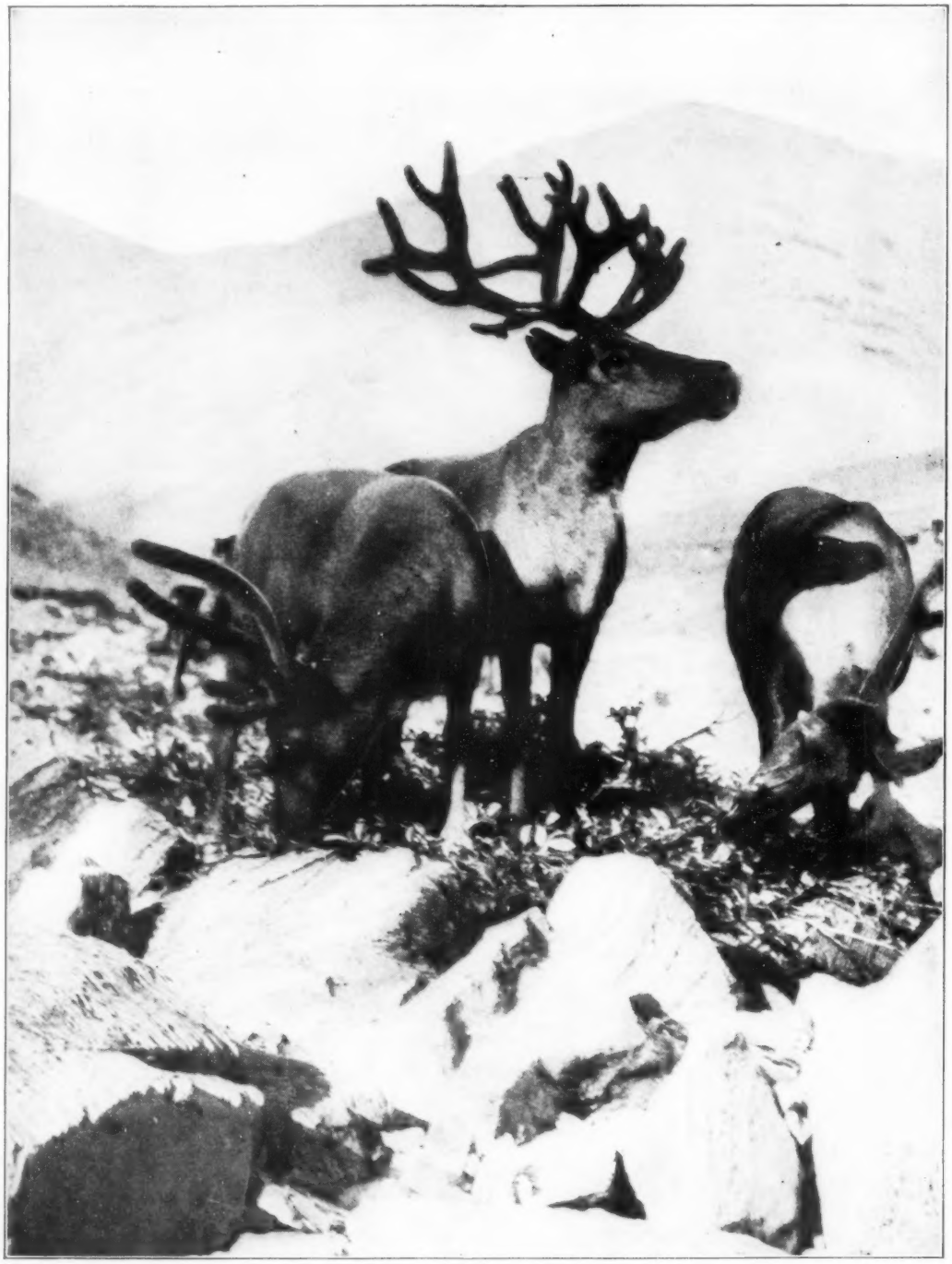
Safety . . . dependability . . . long life . . . speed with stability . . . spaciousness . . . comfort . . . high efficiency . . . and a really wonderful record of performance have won for the Ford tri-motored, all-metal plane the sincere approval of all air-minded America.

The first plane flown in regular passenger-mail service from the Mexican capital to the United States. Col. Lindbergh was at the controls.

FORD MOTOR COMPANY

Henry Fairfield Osborn

PROFESSOR HENRY FAIRFIELD OSBORN, noted paleontologist, student of evolution and President of the widely known American Museum of Natural History, is also President of the American Association for the Advancement of Science, the great general organization which, with its 18,000 members, includes the entire professional personnel of the several branches of science in America. Most of Professor Osborn's distinguished career has centered around the study of organic evolution, as the following reckoning of his very many published scientific papers makes evident: In geology 14 papers; in zoology 35; in comparative anatomy 24; in eugenics 3; in anthropology 30; on evolution 77; in paleontology 285; in psychology 5. Among his best known books are, "From the Greeks to Darwin," a complete survey of pre-Darwinian theories of evolution; "The Age of Mammals," a study of the immense development of mammalian life, including many extinct types, in the Tertiary and Quaternary times of the geologist; "Men of the Old Stone Age," a standard treatise on prehistoric man; "The Origin and Evolution of Life," a study of organic evolution. Of honors, scientific awards, decorations, degrees and medals he has received a lengthy list. Among scientists Dr. Osborn is best known because of his studies of the great mammals, especially the proboscidians, including the mastodons, mammoths, and modern elephants. In 1925, at the time of the famous Scopes evolution trial in Tennessee, he became widely known to the newspaper reading public because of his championship of the cause of evolution, and his opposition to Mr. Bryan and his followers.



Reindeer With Horns In the Velvet

A TRIO of reindeer, summer browsing. This photograph was taken within a few miles of Cape Prince of Wales, Alaska, the westernmost extremity of the North American continent. While the antlers are growing they are said to be "in the velvet," because of the soft membrane and velvety fur in which they are enclosed. Both sexes have horns which are shed annually. The central pair above are a doe and fawn. The fawn is three months old. Note the "swallow fork," a slit in the ear of the middle reindeer, which is an ownership mark.

All photographs courtesy Lomen Brothers

A HERD COMES IN FROM THE RANGE

The largest reindeer herd in Alaska today is many times the size of the largest cattle herd in the United States. Reindeer increase rapidly and with careful handling should double in number every three years—partly due to the hardihood of the fawns

Reindeer as a Source of Food

Vast Pasturages in Alaska Can Support Five Million Reindeer to Supplement Our Decreasing Cattle Supply

BY CARL J. LOMEN

A PATERNAL ACT performed by our government, of introducing the domesticated reindeer into Alaska to improve the living conditions of its wards, the Eskimos, unexpectedly opened a new field for the American stock raiser. It extended the grazing limits of the United States far to the north, adding some 350,000 square miles to the pasturages of our country.

The introduction and raising of the reindeer in Alaska is one of the most constructive efforts ever attempted on the part of our government for the betterment of Alaska and the condition of its people.

America owes its reindeer population to Dr. Sheldon Jackson, United States general agent of education in Alaska. Dr. Jackson made a cruise of northern waters in 1890 on board the Revenue Cutter *Bear*. He found the Siberian native peoples on the west shores of Bering Sea independent due to their herds of domesticated reindeer, while across the waters on the American side the Eskimos were eking out a precarious existence and annually facing starvation due to their dependence on fishing.

Returning to Washington, Dr. Jackson made recommendations to the government, through the Commissioner of Education, urging that reindeer be introduced into Alaska. Pending the securing of a Congressional appropriation, an appeal for funds was made to the general public, through the press and the churches. In this way 2146 dollars were collected, with which were purchased 16 reindeer in 1891 and 171 in 1892. The latter constituted the first of the "mother stock" of the vast herds of today, the 16 secured in 1891 not being breeding stock.

IMPORTATIONS continued until 1902, Congress appropriating the necessary funds, the Revenue Cutter Service co-operating with the Bureau of Education in the purchase of the animals and in their transportation from Siberia to Alaska. The importations totaled 1280. These were all landed on the shores of Port Clarence Bay, near the present location of the thriving little town of Teller.

The reindeer found in Alaska a more equable climate, abundance of forage, and uncontaminated pasturage than in Siberia, and also a lack of natural enemies. They throve, grew larger, and rapidly multiplied. By 1905 the natural increase had brought the number to 10,000. There were 70,000 in 1915, 200,000 in 1920, and by July 1, 1929, there were more than 1,000,000. In addition to this number, more than 300,000 have been used for food and clothing.

It was one thing to bring reindeer to Alaska, but it was quite another problem to train the nomadic hunter of the north in the art of animal husbandry. To make a herdsman of the hunter is a difficult task.

Through the Bureau of Education an apprenticeship system was established. Intelligent young Eskimos were selected and placed with the herds. To assure the success of the enterprise a number of Laps, together with their families, were brought over from northern Norway to teach reindeer husbandry. Four years was the period of apprenticeship and payment

KING OF THE HERD

The reindeer has been man's most valuable domesticated animal in northern Eurasia for centuries past, furnishing both food and clothing. Reindeer meat is now on American menus

for services was made in reindeer and supplies. At the expiration of the four year period the apprentice owned in his own right a small herd of reindeer and moved on to his own range, but still subject to Bureau regulations. The new owner must in turn employ Eskimo apprentices and distribute reindeer to them, as partial payment, thus becoming an additional factor in the extension of the enterprise. To safeguard the industry for the Eskimos, the regulations forbade the disposal of female reindeer to others than Eskimos.

The Lap instructors were reindeer men familiar with the growth of reindeer herds in northern Europe and would not accept employment in Alaska until assured that our government would assist them in establishing herds of their own. Contracts were entered into which provided for the loan of 100 reindeer, a like number to be returned to the govenment at the expiration of five years, the Lap keeping the natural increase.

Illustrative of the rapid growth of reindeer under good management, the following concrete example is given:

In 1901, the Government loaned to Alfred Nilima, a Lap, 24 male and 75 female reindeer. In 1906 Nilima returned 99 animals, keeping the increase. In 1908 he divided his herd of 800 with his Eskimo wife, keeping 400 for himself. As the herd grew, Nilima employed other Laps as herders, paying them, in part, with reindeer. In 1914 he sold his herd, which then numbered 1200. In 1917 his former herders sold 1717 and an additional 1606 in 1921. All this from the natural increase of 99 reindeer.

Through the apprenticeships and Lap contracts many herds were established and, as the reindeer increased in numbers, it became necessary to seek more ranges. Some owners drove their herds north and others south along the coast. Today the country is dotted with herds reaching from the northernmost part of Alaska to the Pacific Ocean and from the Bering Sea coast to the interior along the belt traversed by the Alaska Railroad.

A million reindeer! That number cannot be maintained only as a food supply; a cache from which to feed some 10,000 Eskimos. Including the Indians, the native population of Alaska is less than 30,000. The reindeer population is nearly 35 times as great. Include the white population with the native and we have 20 reindeer for each person in the territory of Alaska. Reindeer herds are increasing at the rate of 39 percent per year. With a grazing area of 350,000 square miles and a grazing unit of 30 acres, Alaska can permanently support more than 5,000,000 reindeer.

THE vast herds are no longer maintained for the sole benefit of the natives, and our Federal Government no longer looks upon it solely as a protection against the starvation of its wards, but also in the light of a promising industry which can be counted upon to produce millions of pounds of meat to augment the declining meat production of the United States and to contribute largely to the productive wealth of its northern treasure chest.

In 1914 there was a large and increasing surplus of animals in many of the herds and the commercial development of the industry became desirable. The same year the first of the Lap contracts expired and the government encouraged the white citizens to enter the industry. A small group of citizens of Nome, Alaska, organized a company and entered upon the work of developing commercially this great and promising industry.

There were many difficulties to meet. The Laps and Eskimos were not progressive and had always been satisfied with their reindeer and ranges without thought of improvement to either. The whites soon learned that many changes were necessary to place the industry on a sound basis. Central stations and many shelter cabins had to be established on the ranges for protecting the herders, and improved corrals, with chutes and runways were constructed for protecting the reindeer. Preparing the meat for market required modern abattoirs and ammonia cold-storage plants, and the transportation of the meat from Alaska to the markets of the United States necessitated ships equipped with refrigerating plants.

In 1920 a Congressional appropriation made it possible for the Bureau of Biological Survey of the Department of Agriculture to extend its work to

Alaska and a Reindeer Experimental Station was established. Grazing and health problems were studied and the industry aided along scientific as well as practical lines.

The whites were interested in the development of better animals, and, in co-operation with the Biological Survey, commenced to improve the herds by eliminating scrub stock and by cross-breeding with the American caribou. As a result of the latter experiment it is already found that the half breed fawn is heavier, at birth, than the full-blood reindeer or caribou fawn. Care must be exercised in this work to prevent breeding into the reindeer too much of the migratory instinct so highly developed in the caribou.

The reindeer is new to America, although old to Eurasia. It is in fact one of the oldest of the domesticated animals and is the most widely distributed mammal of the globe.

PACK REINDEER

Reindeer are occasionally used during the summer and have played a part in the development of Alaska by making it possible for prospectors and others to transfer supplies to remote sections

THE habitat of the reindeer circles the polar region and extends as far south as 52 degrees north latitude in Asia and to 53 degrees north latitude in North America—the island of Umnak of the Aleutian group. In Europe the southern limit is more to the north due to the influence of the Gulf Stream.

The reindeer is of the *Cervidae* family, the genus *rangifer* and the species *rangifer tarandus*. It differs from the ordinary deer in the particular that both the male and the female have antlers, which are shed annually.

Reindeer are gregarious. They flock together like sheep, but graze like cattle. In intelligence and activity they more nearly resemble the horse, being more intelligent than cattle. In spite of the dangerous appearance their large spread of antlers give them, they are the most docile of domesticated animals, and, except during the mating season—September and October—little children might safely play in a corral containing thousands of reindeer.

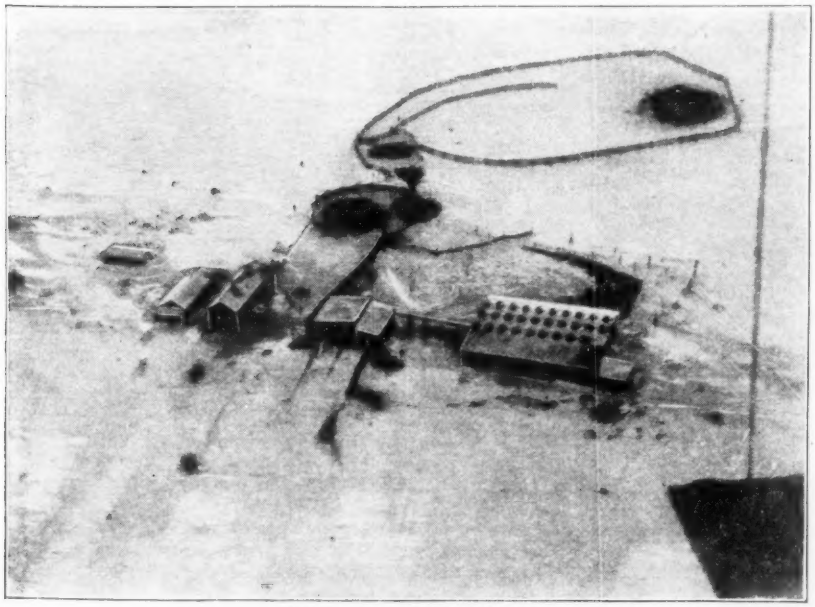
A reindeer "pasture" usually covers hundreds of square miles, and preferably contains highlands with winter feed and lowlands with the more luxurious summer vegetation, the area between constituting spring and fall ranges. The entire range is bounded by natural boundaries, rivers, mountain ranges, and sea coast.

The reindeer prefer the highlands to the costal plains and range inland the greater part of the year. The warm weather of early summer, July and August, combined with the activity of the arctic mosquito, forces the herds out of the hills to the sea coast where they are less molested and find comfort in the cooling waters of the ocean. The reindeer owners take advantage of this natural annual migration, and the marking and counting of the herds are performed during this season of the year.

One of Lapland's philosophers is Johan Turi, author and sage. Writing of the reindeer he says:

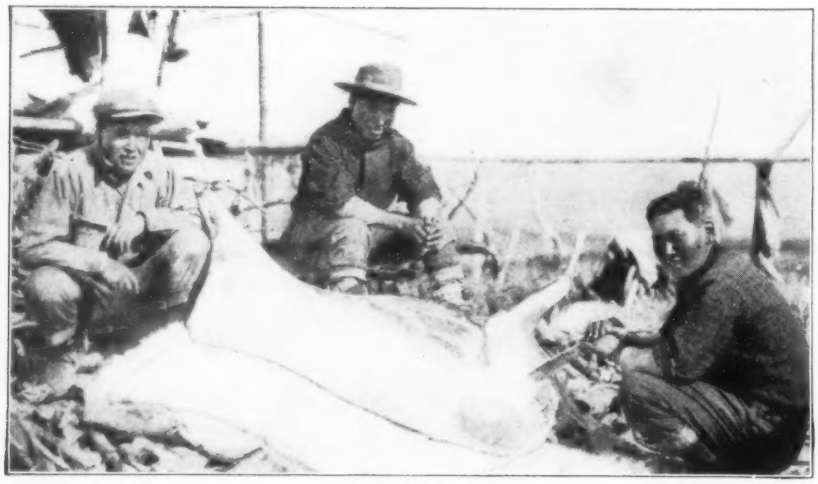
"THE reindeer were created before man, and man was created simply to look after them and follow them wherever they go and support himself by them. In his own estimation, a man is much wiser than the reindeer, but in spite of that, he must trudge along behind the reindeer wherever they wish to go. It is quite reasonable that the reindeer ought to do what man thinks; but man has not the sense to do it just the way the reindeer thinks. Man assumes that he is looking after the reindeer, whereas the reindeer probably thinks he is looking after man."

Unlike most animals, the reindeer prefers to travel against the wind. Heavy hair about his head and shoulders are special protection against cold. So sure are the herders of this animal instinct that during the severe blizzards which often sweep over the country they can seek cabin shelter for themselves for days and still be able to calculate the exact direction and the approximate distance to the point where they can find their herds when



ARCTIC STOCK YARDS

Reindeer are rounded up on the range and brought to the corrals on the coast where the steers are separated and the meat prepared under modern methods in sanitary abattoirs



MEAT FOR CAMP

Eskimos skinning a carcass, for camp use, taken from the natural cold storage at Igloo Point, near Kotzebue Sound, Alaska. Note whiteness of fat and its even distribution

the storm has passed over the range.

The typical reindeer of Alaska is dark brown in color, although the herds contain many white and spotted animals.

The reindeer are not particularly prolific. The doe gives birth to one fawn each year—rarely two. Strong and early fawn sometimes breed the first year.

The reindeer pastures during the summer on tender grasses, sedge, willow buds, mushrooms, and blueberries. During the winter they subsist entirely upon the lichens (reindeer moss). It is the most particular of all domestic animals in the selection of its food, and is particularly free from diseases. The Federal Government recently issued a circular letter on the status of reindeer meat, "For the information of state and municipal health officers, state conservation commissioners, fish and game commissions, and for the information of the general public," which reads in part:—

"REINDEER are not included in the federal meat inspection act, but reindeer meat may be received into the United States and be shipped interstate, and when marked for identification may be received and handled as such in federally inspected plants. It may also be used in the preparation of United States inspected and passed meat and meat-food products when such articles are appropriately labeled.

"The government has maintained experimental stations in Alaska and keeps in touch with the main herds of reindeer. No contagious disease has ever been encountered and no reason has appeared why the sale or use of reindeer meat should require federal, state, or municipal health inspection for the detection of disease . . . . . The reindeer has for many centuries been a domesticated animal and therefore is in no way subject to game laws."

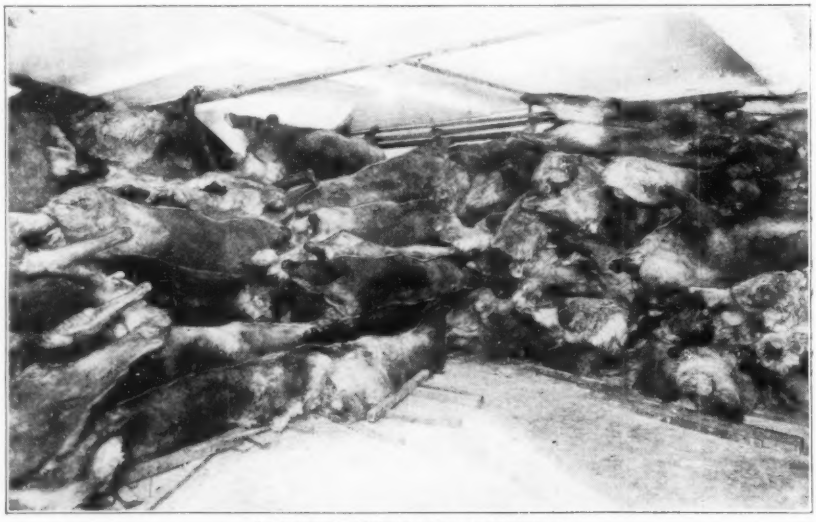
The perennial ice plays another important part in the industry in that it makes possible the construction of natural storage places for meat. One large plant has been constructed at Elephant Point on Kotzebue Sound with a capacity of 10,000 carcasses of meat. A tunnel is run into the frozen hillside and a series of rooms chiselled out in a manner similar to a hallway with rooms on each side, except that the partitions of frozen earth and ice are six to eight feet in thickness. Several cold storage doors are placed between the entrance of the tunnel and the rooms, and doors are placed in the entrance to each room. Ventilation is secured by means of double pipes driven through the roof, one just penetrating the ceiling at one end and the other reaching close to the floor at the opposite end of the room, which gives a free circulation of air. With open air temperatures ranging from 55 degrees below zero, Fahrenheit, to 90 degrees above, the temperature of these rooms varies from 15 degrees to 22 degrees, Fahrenheit, and keeps the meat in perfect condition.

When the full carrying capacity of the northern ranges of Alaska has been reached—probably in less than one generation—there will be available annually for market animals in number equal to the natural increase of the herds, or something in excess of one and a half million. This would represent approximately two hundred million pounds. Two hundred million pounds of meat would require a train of refrigerator cars more than 125 miles in length for distribution throughout the United States. While these figures seem staggering, they represent but little more than a pound and a half per annum for each inhabitant of the United States.

THIS industry is of national importance. The cattle supply of the United States is not equal to the demand. This condition will gradually become more serious. The importation of meat into the United States is necessary now to insure consumers even a moderate meat ration.

North of the cattle belt are grazing lands tremendous in extent. The reindeer is the only domesticated animal which can feed itself from those lands, the year 'round, and can live without shelter. The reindeer will, at the same time, make possible a permanent population over wide areas of the northern country which would otherwise remain uninhabited.

The American people may well be proud of the reindeer industry. It is Alaska's most original contribution to the commerce of the world and is likely to remain one of her greatest.



MEAT IN STORAGE, SEATTLE

Reindeer meat is brought to Seattle, Washington, from Alaska in ships equipped with refrigeration. Here it is held pending shipment to markets of the United States and Europe

OUR POINT OF VIEW

A Nocturnal Menace

ONE can hardly imagine a more ludicrous sight than that of a lumbering elephant carrying equipment developed for, and peculiarly adapted to, speedy automobiles. Yet in Ceylon, automobile owners are urging the authorities to protect them from the trains of merchandise-carrying elephants by providing the huge beasts with head-lights and tail-lights. It is said that these animals are practically invisible at dusk or even under the glare of the automobile lights and, therefore, are the cause of many serious accidents.

While the menace of unlighted pachyderms is a problem of Oriental countries, the United States has its problem in the darkly-clothed and careless nocturnal pedestrian on country roads. It would be a difficult proposition, indeed, to attempt to force such people to carry lights but they could be taught to exercise certain precautions. They should learn that it is dangerous not only to themselves to walk on the right side of the road but also to the motorist who approaches from the rear. Because of the neutral color of the pedestrian's clothes, the driver of a car cannot see him until only a short distance away; and in the event that the driver is blinded by the headlights of an approaching car, the pedestrian is not likely to be seen at all. The result may be a wreck that is disastrous to all. On the other hand, if the pedestrian is walking on the left side of the road, facing traffic, he can see approaching cars and can quickly step aside if a motorist does not see him or is blinded by lights from another car.

Man Versus the Insect

REITERATION of the pessimistic prophecy that man will, in time, be conquered by hordes of insects, often puzzles the layman. "There was a time," he will argue, "when a handful of human beings on earth held their own not only against insects but also ferocious beasts. Why then, with his infinitely greater numbers, his superior knowledge of combative methods, of poisons, and of the insects themselves, can he not effectively control insect pests at present?"

Before man had colonized much of the earth, a natural balance was maintained by living things. While the upsetting of this balance by the destruction of certain natural enemies of insects—notably, the birds—has much to do with the question, man's economic problems are more pointedly involved. To meet the necessity for food or the whims of taste, he now brings goods in ships from far corners of the world. And in those shipments, undesirable aliens, in the form of insect pests the ravages of which have hitherto been limited to certain localities, are brought in unwittingly. In his former abode, perhaps the immigrant insect was kept down by an enemy insect but in his new home is troubled by no such natural foe. Consequently, he thrives.

To our shores have come such devastating pests as the Japanese beetle and the European corn borer; and now the Mediterranean fruit fly, long dreaded and carefully guarded against, has made his appearance in Florida. Its presence there has resulted in a quarantine for certain sections of the state and, if it spreads, will mean perhaps a quarantine for the entire state. Already, Congress has appropriated 4,250,000 dollars with which to fight this migrant.

While we do not subscribe to the pessimism of those who foresee man's enslavement by the insects, we do realize the magnitude of the problem that confronts the nation. The Department of Agriculture spares no expense or effort in finding ways and means of combating our native and alien insect pests, but the co-operation of the individual is absolutely necessary. Only by strict observation of quarantines and adherence to the Department's regulatory measures will the nation be able to control these destroying creatures.

Snake Bite

THE recent death of Charles E. Snyder, head keeper of the New York Zoological Gardens, from the bite of a rattlesnake, evoked an avalanche of letters to the press relative to snake bite remedies. Some endeavored to show proof in support of the myth that whisky is an efficacious remedy. The majority, however, took the opposite view, and with good reason—note the remarks of a famous herpetologist on page 134 of this issue.

"The important thing to do when bitten by a venomous snake," says Dr. Daniel Davenport, F.Z.S., who was bitten by a cobra while on an expedition to Africa, and survived, "is to keep calm. Don't suck the wound as a fatal amount of poison may be absorbed by the mucous membranes. Don't drink whisky. If location of the bite allows, place a tourniquet between the wound and the heart. After 15 minutes, release the pressure for 20 seconds, then re-apply pressure, and repeat for an hour, gradually increasing the blood flow to one half, then a full minute." This is excellent advice.

Persons going into regions infested with poisonous snakes should carry with them a supply of anti-venin, the scientific and most certain of all remedies, which is issued under license by the United States Public Health Service and is obtainable at drug stores. If this is not available, a 10-cent box of potassium permanganate should be carried. Long recognized as a powerful remedy for snake bite when rubbed into the wound in crystal form or in solution, the permanganate may be purchased at any drug store.

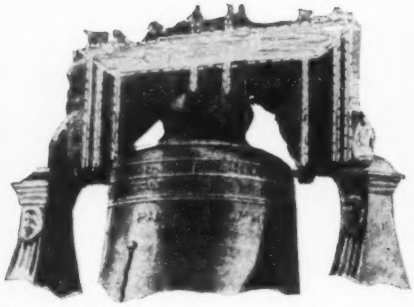
Guilty Cities

IN the atmosphere over New York City there is a floating mass of dust and dirt amounting to 2200 tons daily, according to an estimate of Professor H. H. Sheldon, of New York University, who has just made a laboratory analysis of the air for the Smoke Nuisance Committee. In other cities the condition is even worse.

Smoke accounts for much of the pollution of city air, and methods of combating it have been worked out in detail. But how many cities consider the incidental causes of this pollution? Or, having considered it, have rigidly enforced corrective measures? In city streets we have often seen great open trucks speeding along loaded with ashes, a veritable pall of ashes swirling behind them because those ashes were not covered as they should have been. We have seen men load these trucks carelessly so that great clouds of ashes were swept into the streets to be caught in the rush of traffic and scattered broadcast.

Why is this lax system tolerated? Complaints are often made but seem always to be pigeon-holed. Is it that municipal authorities are so bound up with red tape that such *minor* matters never get farther than the third assistant secretary to the secretary of the Man-of-Action? It is up to someone to get next to that last named person, whatever his title may be—to show him the situation as it is and point out to him how he can remedy it, to some degree at least, by the use of covered refuse trucks similar to those described in the SCIENTIFIC AMERICAN Digest of this issue.

Camera Shots of Scientific Events



ITS ORIGINAL YOKE IS SAVED

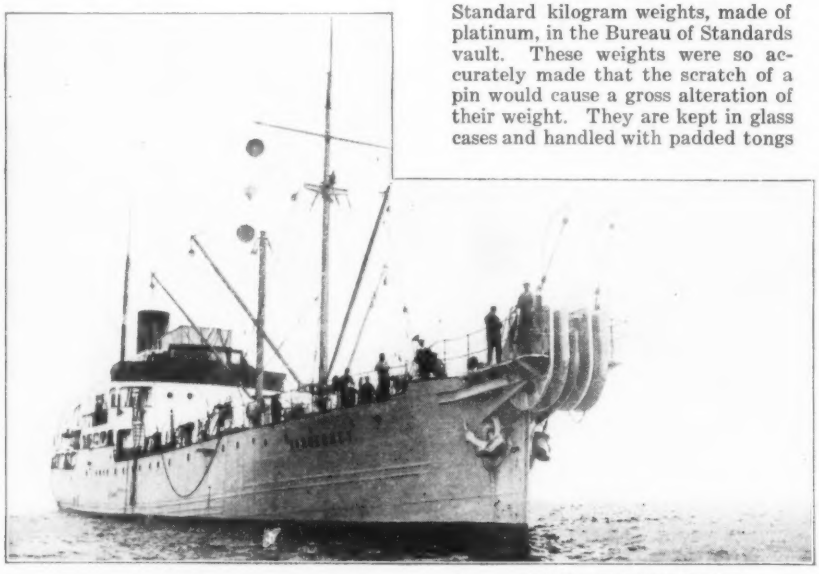
The 176-year old timber yoke of the Liberty Bell seemed doomed. Dry rot had attacked it. Franklin Institute engineers suggested reinforcing it. Now it is no longer in danger, for steel capable of supporting 10,000 pounds has been inserted in the wood (the bell weighs just over a ton). At left is the bell as it appears today, the reinforcing in the old yoke being invisible; at right, a phantom of the reinforcing

HANDLE WITH CARE

Standard kilogram weights, made of platinum, in the Bureau of Standards vault. These weights were so accurately made that the scratch of a pin would cause a gross alteration of their weight. They are kept in glass cases and handled with padded tongs

AS IN OLDEN TIMES

Gold beating is an art that can not be done other than by hand. Gold, 23 carats fine, is rolled into thin ribbons, cut into squares, then many layers of it are placed between parchment and beaten four hours. The squares are quartered, placed between gold-beater's skins, beaten four hours, and then again for six hours



▲ SHIP'S PROBOSCIS?

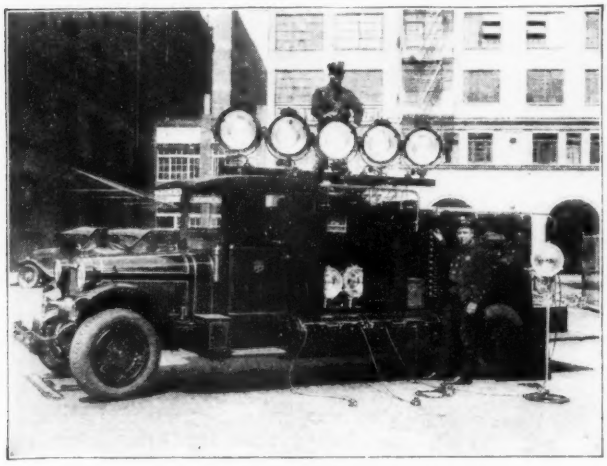
After five months of arduous labor, the laying of a new cable between Norrtelje, Sweden, and Abo, Finland, was recently completed. In some places the cable was laid at a depth of 780 feet. A feature of this system of through long distance cables is that nine conversations can be carried on at one time. The photograph shows the cable-laying ship, *Norderney*, with which the job was accomplished. One of the peculiar cable runways, overhanging the ship's bow, is shown

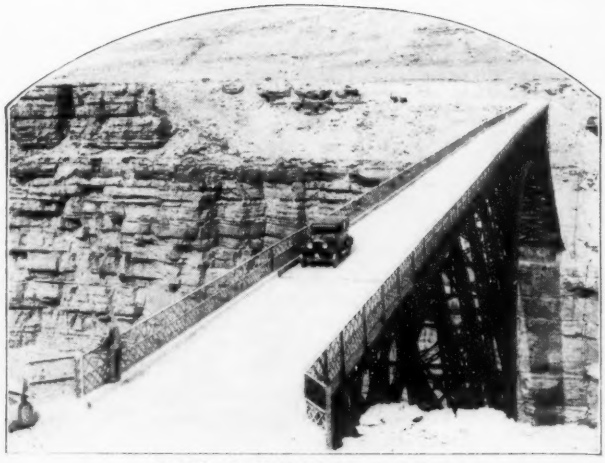
◀ BEAUTIFYING WASHINGTON

Approved and supported by President Hoover, plans to make Washington the city beautiful with the addition of new buildings are well on the road to realization. Mr. Hoover and Mr. Mellon recently viewed the models of the new buildings exhibited in the building of the United States Chamber of Commerce

SEARCHLIGHTS FOR FIRE FIGHTERS

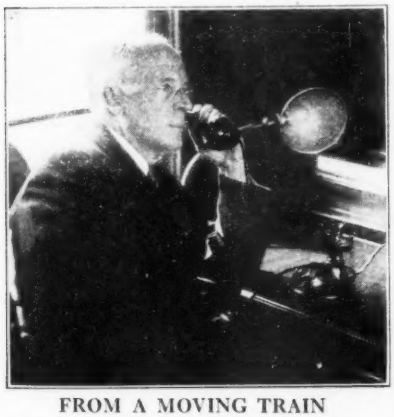
Built in San Francisco from designs by Sam Birmingham, of the Board of Public Works, this traveling electric plant went into fire department service in that city recently. A 10-kilowatt generator provides current for five 1000-watt searchlights and eight 400-watt lights on cables for use in fighting fires





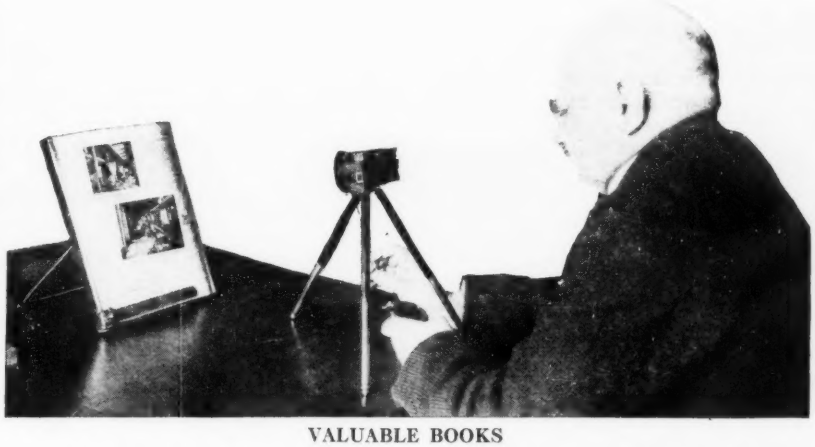
NEW AUTOMOBILE ROUTE

The Hamblin-Hastelle Bridge, as the span over the Grand Canyon at Lee's Ferry is now known, was dedicated in June in a celebration in which officials of both Arizona and Utah participated. The 834-foot concrete floor of this bridge provides a connecting motor highway link between the states



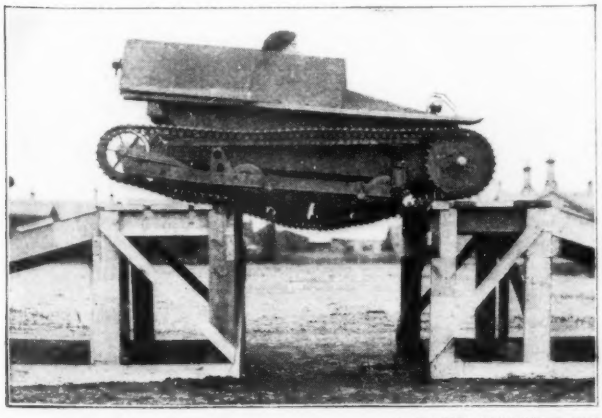
FROM A MOVING TRAIN

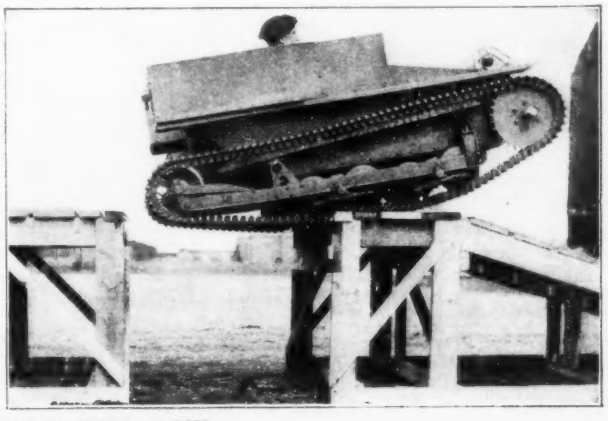
The Canadian National Railways recently inaugurated a telephone-from-train service on one of its fast trains so that passengers may talk to any point on the continent while the train is moving. Here Mr. W. D. Robb, vice president of the road, is shown talking from a moving train



VALUABLE BOOKS

Practically every big library has among its collection a number of precious books of which there exists but a single copy. Naturally there is great risk when these are loaned. To prevent this, the Berlin State Library is using a special apparatus to photograph every page of such books. When the photographs are enlarged, the books may be read in the reproduction so that wear of the original is prevented





A JACK RABBIT OF THE BRITISH ARMY

Since the World War, great progress has been made in the design of fighting tanks. They are speedier, have greater maneuverability, and are capable of making long runs without an overhaul. Engines, treads, and armor have been improved, and the whole has been balanced so well that the machines can cross such "trenches" as the wooden one here. A tank of the Third Battalion, Royal Tank Corps, British Army, rehearses for the Royal Tournament

Diatoms

These Lowly Microscopic Forms of Life Provide a Fascinating Hobby for the Amateur Scientist, but Their Industrial Uses Give Them Immense Economic Significance

BY HAROLD McFADDEN

ONE of the surprising paradoxes of this world of ours is that the things we use the most are often the things we hear the least about. Probably the most apparent example of that is the automobile; with millions of them running around, only about one person in a thousand has any idea of what makes the wheels go 'round, or why it goes faster when you step on the gas.

Of that class is the diatom which, although forming the very foundations of commerce, is scarcely known by the general public to be in existence. Yet the average man polishes his teeth with diatoms, shines his automobile with them, and then washes his hands with a soap containing the same things. He rides to work over smooth asphalt roads that are held in place by these invisible things, works in a huge concrete office building that required tons of them in the construction work, and then eats his lunch on a composition table top containing them. He pays for his lunch check, which probably is printed on a paper containing them, returns home at night after buying gasoline and oil that has been filtered through them and spends the evening in his home, which has been insulated and sound proofed with them—all the while never dreaming that he ever has consciously seen, felt, smelled, or heard of such a thing as a diatom.

PROBABLY the main reason for that is because the diatom is virtually invisible to the naked eye. Like many other articles of general use and necessity, it needs a microscope to disclose its nature. The diatom is a microscopic plant—one of the most abundant of all living things—a body of protoplasm encased in the honeycomb-like cells of a silica shell, and living in the fresh and sea waters of the world. Diatomaceous earth, the commercial product, is composed of the skeleton shells of the diatom plants which were deposited on the bottoms of water bodies and later raised to land level by an upheaval of some sort. Diatomaceous deposits are found in all lands of the earth, but the largest and purest of them are those of California and adjoining Pacific coast states.

First described in 1703 and 1704 in papers of the Royal Society, although known previous to that, there followed a period of more than 200 years in

LOOKING AT DIATOMS

Dr. Walter Herzberg, who makes the study of diatomaceous earth a hobby and an avocation, using a powerful microscope

which famed scientists of the world argued whether to class them as animals or plants. Because of the fact that they had characteristics of both families, neither the botanists nor the zoologists wanted to claim them. As a result, the poor little diatom remained an orphan until early in this century when the discovery that chlorophyll was its coloring matter definitely established that it was a plant, and therefore botanical.

The orphan diatoms received a baptismal name about 1805. The

Photomicrograph by Dr. Walter Herzberg

"HOUSEHOLD" DIATOMS

White's Polishing Cream contains these forms as a mild scouring agent. Note their variety. There are many other forms

microscope was far from perfection in those days and as a result, about all the scientists could see of them was that they were very small, and that each one grew double, having two sides held together with a band or girdle, much after the manner of a pill box with a removable top and bottom. They learned that the reproductive process consisted of the two halves casting off the girdle and separating, each half in turn growing a girdle of its own. Because of that fact, the scientific men of the early nineteenth century named the plants diatoms, referring to the fact that they divide longitudinally (Greek *dia tomeo*, to cut through), and not, as has been asserted by some naïve individuals, because they might be said to resemble "two atoms" (the word is accented on the "di" and the "di" rhymes with "eye." The last syllable is exactly like the name Tom).

Until now there have been discovered about 8000 different kinds of diatoms composing 150 families, and new varieties are being located continually.

HOWEVER, the complexity of the diatom forms need be no barrier to the layman who desires to find them for himself. There are a number of very low priced microscopes that will reveal to him not only the diatom, but also another world of things, the very existence of which he has not even dreamed. A student-type microscope with a power of magnification from 50 to 150 diameters is sufficient for the beginner and, if desired, an additional eyepiece may be obtained later that will increase its power to 250 diameters.

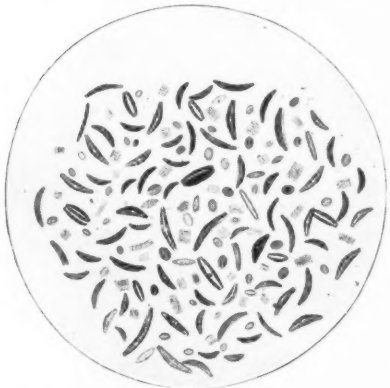
Diatoms are of two general types, fresh-water and marine, and seem to require only light and water to thrive. They are found alive in fresh, brackish, and sea water, but never in water that abounds with putrefaction, or water of extreme salinity such as the Salton Sea or the Great Salt Lake. Neither will they live in pure or non-aerated water; and yet, in Yellowstone Park they apparently thrive in some pools that have a high arsenic content. They are found in the pack ice water of the arctic, at a temperature of about 30 degrees, Fahrenheit, and in the pools at Hot Springs, West Virginia, where the temperature is 126 degrees. Altitude seems to be no barrier to their

growth as they have been collected in the Alps by the side of a melting ice formation at an altitude of 12,000 feet.

Therefore, it will be seen that anyone desiring to find his own diatoms will have no trouble in locating sources of supply that will keep him busy for many years on new varieties. In most cases it will not even be necessary to leave one's own home. Where the water supply is obtained from storage reservoirs, lakes, or rivers, a plentiful supply can be obtained directly from the tap. They will not be found, however, in water that is pumped from deep wells or springs.

THE method is simple. Tie a cambric handkerchief over the mouth of the faucet and allow the water to run softly for about one half hour. Carefully untie the handkerchief and swish that part which has acted as a filter in a vial of distilled water. Place a drop of this water on a microscope glass slide and on it lay a cover glass. Set the microscope at 100 diameters and have a good light, but not too bright, focused underneath the slide. It is best to locate the organisms first with the low power and then raise the instrument to a higher power for closer examination. As some of the organisms in the drop of water will be transparent and almost invisible in white light it is well to own an inexpensive color filter.

The student will have some trouble at first in differentiating between diatoms, desmids, infusoria, and other forms of minute life, but after a little study and with the aid of a text book*



AFTER CLEANSING

The same lot shown in the upper illustration sorted out and magnified about 75 diameters. Their beauty is most striking

on the microscope a fair degree of proficiency will be obtained. Close observation and a good memory for details are the chief stock of the expert microscopist.

The student also will find a myriad of diatom forms by scraping the surface of leaves, stones, and sticks found along the edge of ponds, lakes, and rivers. The scrapings are put into vials of distilled water and the operation with the microscope is the same as described with tap water. The tiny plants also may be obtained by squeezing the water from algae or green slime found along the edges of slow running streams or in ponds.

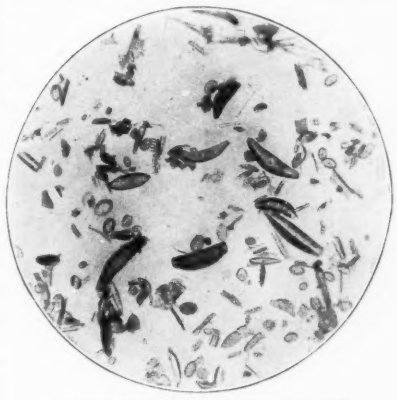
Skeleton forms of diatoms or diatomaceous earth deposits present a greater difficulty for the amateur to locate, having little outward indication of being different from a chalk or limestone deposit. However, if the student succeeds in locating one deposit of the earth, others will be fairly easy to recognize.

As with the higher species of life, there are diatoms which favor certain temperatures to the exclusion of others, but the majority seem to favor the cooler water, and the species of the arctic regions are 10 times as numerous as those of the tropics. The reproduction interval is shorter in cooler temperatures; in the arctic it is from three to six hours and in the tropics from 20 to 24 hours.

RAISING diatoms is an easy business. Some painstaking scientist figured that if you started off with one diatom of a class that had a habit of dividing into two every 10 hours, in 30 days you would have, theoretically, one thousand million, or, to make it look bigger, 1,000,000,000. Another good example of the abundance of the plants is to be found in tests made on the North Pacific Ocean off the Island of Unimac. A quart of water taken there was estimated to contain 7,850,000 diatoms. Five or six million to the quart are more or less common in the seas north of 60 degrees north latitude, while in the waters south of 60 degrees south latitude, with the temperatures identical with those of the north, the count seldom runs to more than one half million to the quart.

About this time the layman usually asks, "What good are diatoms?" and "What do they look like to the naked eye?" To answer the first question hundreds of scientists have devoted their lifetime to the study of the mysterious plants; in fact it was primarily because of the desire to learn the internal structure of the diatom that the microscope was brought to its present state of perfection.

However, with our present knowledge, the microscope has reached its limit of power, yet microscopists are far from knowing the complicated internal structure of the diatom—a silica shell of such intricate construction that the most powerful microscope leaves intimate detail to imagination. The second question easily is answered. When alive in water, a single plant is invisible to the naked eye, but enough of them will add color to the water. The shells or skeletons of the dead plants (diatomaceous earth) appear very much like lumps of chalk, very light in weight.



MISCELLANEOUS DIATOMS

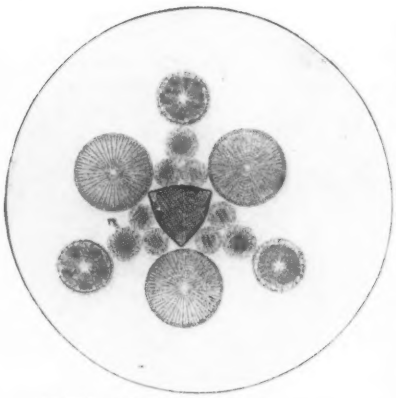
Before being cleaned and classified, a sample may look like this when studied

The first actual use of diatomaceous earth on record was by the Romans in 522 A.D. in making what were termed "swimming bricks." Emperor Justinian ordered the dome of the Church of Santa Sophia built of that material in order to lighten the weight of the structure. The first commercial use of diatomaceous earth in the United States was in 1865, in the manufacture of Zozodont tooth powder. The diatoms were taken from a fresh-water deposit in Beddington, Maine. The next use of importance was in 1873 when a metal polish, Wright's Silver Cream, was first manufactured from a fresh-water deposit at Keene, New Hampshire.

IN 1888, the deposits in Nevada were opened and the material was shipped to England. Some of it came back to us in the form of Electro-Silicon and Silver White, both metal polishes. The remainder of the diatomaceous earth sent to England was used for the absorption of liquid manure. That is the first record of the use of the western deposits, and also the first foreign shipment of the material.

When, a few years later, the California deposits were put to use, scientists had found applications for the material which required gross quantities, in comparison with the tooth powder business where a carload would stock the manufacturer for a year. Probably the most common use is admixture with cement, to make the mixture flow more easily when poured and to give it a smooth surface free

*For the beginner the most suitable book is Plaskitt's "Microscopic Fresh Water Life," as it contains practical instructions. Other books are: Needham and Lloyd, "Life of Inland Waters"; Shipley's "Hunting Under the Microscope," and Ward and Whipple's "Fresh Water Biology." On the microscope itself, see Gage, "The Microscope." If enough direct requests are received, more articles on microscopic fresh water life will be published later. Its observation is a fascinating hobby.—The Editor.



Photomicrograph by Dr. Walter Herzberg

ARTIFICIALLY ARRANGED

A group from various parts of the world. Diatoms have worldwide distribution

from air pockets. The diatom in the cement mix also makes it more durable, aids materially in preventing excessive shrinkage, and speeds the setting process.

With the demand for diatomaceous earth in huge quantities came hundreds of unforeseen difficulties in mining and preparation of the material. The chief value of the diatom is in its sieve-like structure. It is of almost pure silica, but that alone is of little unusual value. Therefore it was logical that the common practice of grinding non-metallic minerals would not be of value for diatoms, for the very apparent reason that the grinding would destroy the plant shells and the resultant product would be merely a finely powdered silica.

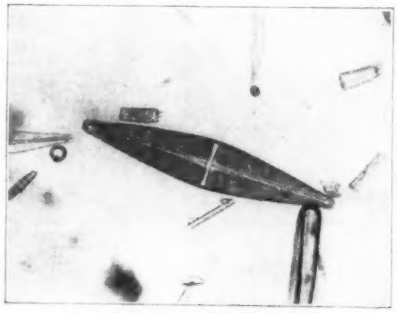
MILLIONS of dollars were spent in the development of suitable machinery for breaking up the bulk material and sorting it according to size and purity. More than one group of business men in California have learned to their sorrow that the diatom seems to be guided at times by the "imp of the perverse." Hundreds of companies have been formed in the western states for exploiting diatoms, but less than a dozen have survived.

An example of the perverseness of the plant shells is the problem of sorting the material after it is broken up. Most ordinary non-metallic minerals can be segregated to size by means of screens of various size mesh. However, the diatom refuses to be screened. If you doubt that, take a handful of the material, which looks much like fine clay, place it on a 200 mesh screen and shake it. After a great amount of physical exertion, you will have about a tablespoon full of diatoms which passed through the screen and the remainder will be clinging as tenaciously as molasses to the wire mesh. Diatoms are, however, easily separated by several other methods. The chief one is by air blast.

This quality of interlocking, also of porosity, makes the diatomaceous earth one of the most valuable filtration materials. It is probable that more research has been done with diatoms for that purpose than any other, for here it has a broad application and the research work has been done in an effort to establish the proper degree of fineness suitable for the most desirable particle structure to prevent sliming and compacting in filter presses.

In the sugar and oil industries diatomaceous earth finds almost universal application. There has been a most noticeable advance in the clarity of extracted vegetable oils through its proper use. It is used extensively in the filtration of wines, beers, syrups, and in fact almost everything where filtration is practiced. As diatoms are of many different geometric shapes and sizes, according to locality, the secret of an application in filtration work is merely that of the selection of the proper kind of diatom for the work to be performed.

One of the most recent uses to which



DIATOMS IN COMMERCE

If you have used Zozodont tooth powder you have used millions of these diatoms

the diatom has been put is that of mixing with asphalt paving material to prevent the sun from drawing the solvents to the surface and causing a softening which results in a "washboard" or rolling surface. The natural locking properties also act to hold the material itself in place.

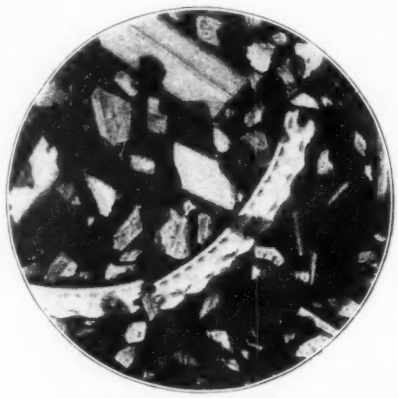
Another extensive use of diatomaceous earth is as a thermal insulator. Because of its porous nature and small point of contact, diatom upon diatom, it has a very low thermal conductivity, while the silica of its composition has a very high melting point—about 1950 degrees, Fahrenheit. Thus it is used as brick-tile pipe covering, thermal cement, loosely granular as a jacket for steam boilers, high temperature ovens, cookers, furnaces, annealing pits, refractory brick, evaporators, and stills. For low-temperature insulation, it is used in cold storage and refrigeration plants and as a filler for ice boxes and coolers. Because of the same physical properties that make the material valuable as an insulator, it is applicable as a sound-proofing material in the floors and walls of buildings and, as such, is now used.

Other uses include that of a filler in the manufacture of paper, a base for several brands of fire-resisting paint, and as a filler in a number of scouring and hand soaps. Its abrasive qualities are very mild and for that reason, many polishing powders for use in delicate jewelry work are made from it. Formerly it was used as the abrasive in matches and as a filler in dynamite, but those two uses have been replaced with more adaptable substances. The material also finds use in the absorption of waste liquids in various processes and stages of manufacturing.

RECENTLY a clay tile and pottery plant brought out some unusual finishes in its products by using diatomaceous earth in the glazing material. The surface of the materials, while as hard as other glazes, had the appearance and "feel" of soft kid leather.

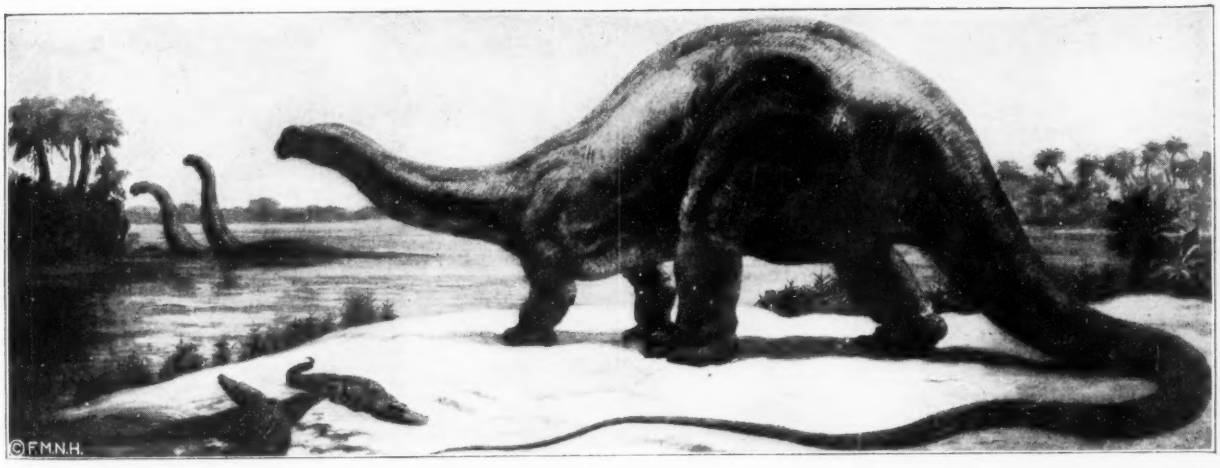
In the United States important deposits of diatomaceous earth are found in California, New York, Virginia, and Maryland; and to a lesser extent in Connecticut, Massachusetts, Florida, Nevada, and Washington. The annual output in the United States is above a million dollars. Europe is plentifully supplied by its own deposits, but the world demand is said to be growing and the discovery of new uses is not unlikely.

The uses of the mysterious little diatom are legion and probably within the next 10 years its adaptability will be increased. Each day brings new uses and improved applications of old ones. One of the strange things about the many applications of the material is that a great number of them have been made by men who knew little or nothing of the physical nature of the diatom; some indeed, did not even know of the existence of the diatom plants and carried on their experiments thinking they merely were working with a new kind of non-metallic mineral.



MAGNIFIED 4400 TIMES

Cross-section of diatoms in asphalt mixture, showing how they bind the material together, which is their function



Giant Inhabitants of Our Continent, More Than 100,000,000 Years Ago

THE ancient dinosaurs are a never-ending source of fascination to scientist and layman alike. This may be partly due to their great bulk—although we have today a much larger living animal, the whale. But is not the chief reason the fact that the dinosaurs are extinct, and therefore that we have never seen them? In fact no human being, not even primitive man, has ever seen a dinosaur, for there is no evidence that a single one of them survived past the end of the Cretaceous Period, nearly 100,000,000 years ago. Just why the dinosaurs became extinct is still a puzzle. Several theories are listed in textbooks of geology, the most intriguing one being that the small, rapidly evolving mammals of that time—remote ancestors, incidentally, to man—destroyed their eggs. The dinosaurs depicted above were painted by the scientific artist Charles R. Knight. The length of the original paintings, which are now permanently attached to the walls of the Graham Hall of Historical Geology at the great Field Museum of Natural History, in Chicago, is 25 feet. The upper painting shows the mammoth tyrannosaurus (right) about to engage in a duel with the only contemporaneous creature capable of giving him a worthy battle, the triceratops. The middle picture shows the brontosaur, which was a vegetarian. Below is a mosasaur, a kind of predatory "sea-going" dinosaur 25 feet long; also a flock of pterodactyls, flying reptiles.

A MODERN POST-WAR SMALL BLIMP

The *Puritan*, a late American design. Her sister ship, the *Pilgrim*, has made more than 500 trips in a year and a half on a single filling of helium. An interesting story is told that the British, during the war, classed such ships as "B" limp; hence the present name "blimp"

The 'Old Rubber Cow:' The Blimp

Non-rigid Scouting and Observation Dirigible of War-time Is Slow but Sure; It Has Great Commercial Possibilities

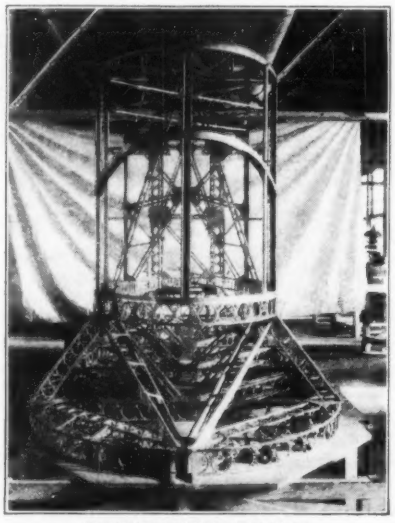
By JOHN T. ROWLAND

THE small dirigibles which were used for scouting and observation purposes, and especially those employed in the coastal patrol, made a war record as extraordinary as it is little known. Duty done, they faded from sight and mind. Today you will occasionally see a blimp exercising itself above a British, French, Italian, or American naval base; but the breed is rare. It has been eclipsed on the one hand by the airplane, and on the other by the huge rigid dirigible which is the only lighter-than-air ship to have received great attention from civilian minds.

THIS is extraordinary in view of the proven superiority of the blimp for certain kinds of work. Perhaps to some people it is a new idea that it can ever be more advantageous to move slowly, rather than fast, so we shall adduce a few concrete cases; for

(1) aerial photography and map making; for
(2) meteorological observations aloft, over a period of time; for
(3) timber cruising to estimate stand of sound timber, percentage burnt over, et cetera. This calls for close and unhurried scrutiny; for
(4) forest rangers' patrol on lookout for fires; and for
(5) exploration.

The list might be indefinitely extended, because it would contain every sort of travel where the thing that counts is observation rather than speed. And the point is that the airplane *cannot* go slowly; its very life depends upon high speed. Skillful pilots offset this disability to some extent, but until they can cut off power and soar for long periods, their planes will not equal the blimp in this respect, and even then they will not succeed in hovering motionless over a given spot or in drifting with a favoring wind. In these two achievements the lighter-than-air craft stands unique, and in the very nature of things must always do so. Its advantage at times may be very great.



BLIMP CABIN FRAME

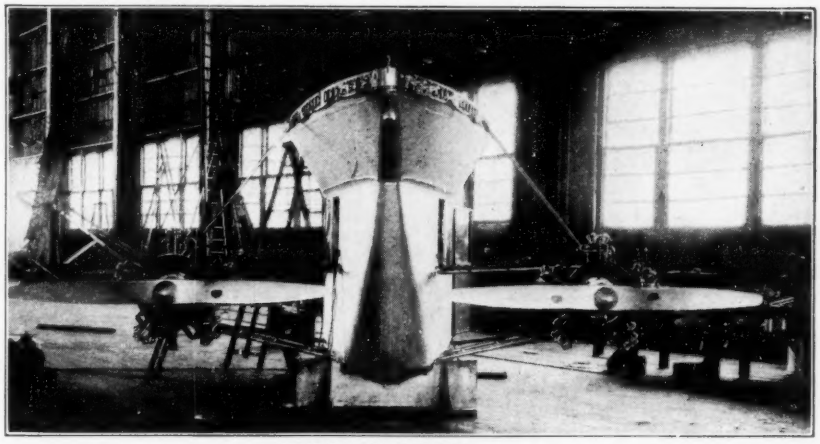
This view of the cabin, or gondola, of a blimp (upside down) shows structure

A notion prevails that the blimp (by which we mean the small non-rigid dirigible) is an awkward, unwieldy, and uncertain ship to handle, particularly in high winds. This idea proceeds from sheer ignorance of the facts; the records of the British Naval Air Service show surprising evidence the other way. For example: Coastal blimp number 9 was inflated at her base in Cornwall on July 1, 1916, and was not deflated until September, 1918. She remained in commission for two years and two months, and during that period spent 2500 hours in the air, or an average of three hours per day.

AT the same station there were only eight days without air patrol between the months of January and November, 1918. This was a particularly stormy winter and spring; no clumsy or un-airworthy ship could have survived it, yet it was nothing unusual to see blimps maneuvering in perfect comfort when our destroyers were laboring in a heavy sea. I remember thinking that the blimps patrolling the south coast of Ireland took a great chance of being blown offshore and lost at sea in the heavy gales which frequently blew from the northwest. One day we saw one coming towards us,

and stood by to rescue her. But when she had come within a hundred yards or so, she nosed up into the wind and lay there while one of her crew semaphored a message to us. Then she headed back inshore—and went there far more comfortably than we were able to follow in the destroyer.

Another and more cogent objection has to do with the difficulty of housing a blimp. A larger hangar is required than for a plane, and it is difficult to get a blimp into or out of a hangar when the wind is wrong. But natural shelter, such as that offered by hills and woods, is a great help; and it has been found entirely practical to house the smaller blimps in a clearing cut out of the heart of a fairly dense woods, without any building at all. Still, it must be admitted that this is a problem not yet completely solved.



TWIN-MOTOR POWERED

Rear view of completed cabin of a modern blimp, showing the two air-cooled motors which drive "pusher" propellers. It will be noted that motors are accessible for minor repairs

BUT the most serious objection to all lighter-than-air craft is the practice of inflating them with hydrogen, one of the most inflammable of gases. To this source may be attributed some of the worst accidents in recent years. It is a quite needless hazard. The natural gas produced by nature's hand in certain parts of this country contains, along with other ingredients, the rare helium gas which is only a trifle heavier than hydrogen and is absolutely non-explosive. It is the ideal substance for the inflation of dirigibles, both large and small. Helium is recovered from natural gas by a rather costly process of liquefaction and regenerative distillation.

Experts who have studied the problem state that great economies may be effected as soon as there is a sufficient demand for helium to warrant its commercial recovery on a larger scale. It is not, however, the initial cost that counts so much as the loss of gas from the evelope and the necessity of replenishing it. This loss occurs mainly in two ways: (1) by leakage through the fabric and (2) by "valving," or permitting the gas to escape. Improvements in the fabric have made it so nearly gas tight that item (1) is almost negligible save for long periods of time, but valving is unfortunately a necessity incident to the maneuvering of a ship under conditions which frequently arise.

What happens is that the gas with which the envelope is filled at a given condition of temperature and atmospheric pressure, expands rapidly when its temperature increases due to the sun's heat, or when the ship has risen to an altitude where the pressure of the surrounding air is less. In all modern airships the envelope is provided with an expansion chamber to take up this increase in volume of the gas. This chamber may be simply a portion of the envelope, separated from the gas-filled portion by a fabric diaphragm, or it may be a sort of fabric bottle lying within the envelope and communicating with the outer air by a pipe. In either case the chamber is kept filled with air at a pressure slightly in excess of atmospheric, which is maintained by an air scoop or a fan and serves to keep the envelope snugly inflated. When the gas expands, this chamber correspondingly shrinks and the pressure within the envelope as a whole remains unchanged. The difficulty comes when the expansion is more than can be taken care of in this way. Since the envelope is not designed to withstand great internal pressure, the pilot must then open his escape valve and let some of the gas out in order to avoid disaster.

Still another troublesome factor enters in. When the gas has expanded sufficiently to occupy most of the space formerly taken up by air, it follows that the buoyancy of the ship is increased, and she will tend to rise. If the pilot cannot overcome this by "nosing down" she will go higher and higher until he valves off gas and allows her to descend.

FIRST TO BE FILLED WITH HELIUM

United States non-rigid dirigible *C-7*. Airships of this general type were dubbed "Old Rubber Cows" by war-time flyers, a nickname originally applied to "sausage" balloons

IN the big rigids an extremely ingenious device has been developed to get the best of this danger by collecting water vapor from the atmosphere. This overcomes the too-great buoyancy of the ship and brings her down to the desired level. The apparatus is rather cumbersome for a small blimp, but perhaps some modification may be devised. It also compensates for the loss of weight through expenditure of fuel.

It will occur to the reader that these difficulties are of a nature susceptible to conquest by further experiment and study. Too much credit cannot be given the army and navy fliers who have devoted their efforts to this task, as well as to a very few private individuals

A "PARKED" BLIMP

Note the caster landing wheel and the air scoops for maintaining full bag inflation

and firms. Foremost among the latter is the Goodyear Zeppelin Company, of Akron, Ohio, which has made some notable advances both in the manufacture of the fabric and in the design and construction of the ship. Their experimental "pony blimp," *Puritan*, which cruised east to New York this past autumn, demonstrated what the smallest non-rigid can do. This little ship, 128 feet long by 37 feet diameter, with a gas capacity of only 86,000 cubic feet, has a useful lift of 1132 pounds and a range of 340 miles at 46 miles per hour on one filling of the tanks. Her maximum speed is 56 miles per hour. She is powered with two five-cylinder radial air-cooled motors, developing 70 horsepower each. As at present arranged, she carries 332 pounds of gas and oil, which leaves a capacity of 800 pounds to be divided among pilot, passengers, and goods She has an enclosed cabin and can be handled by one man.

THIS type of ship has a tremendous advantage over the plane in every sort of work where it is necessary to come close to or maintain contact with the ground. Even when a landing might be impracticable, due to strong winds, the blimp can come down low and hover, heading into the wind and turning over her propellers fast enough to remain motionless in air. In this situation she may quite easily discharge or receive packages, messages, and even passengers, using a lowering line or rope ladder (in the latter case) for the purpose. Crashed aviators have been rescued by blimps from places where a plane could not possibly land.

As an adjunct to the airplane the blimp should fill a useful role in the postal service by collecting the mails in remote districts where there are no railroads and where planes cannot land. To the Geological Survey and the Coast and Geodetic Survey, the use of small blimps to maintain contact with parties in isolated and inaccessible locations might well prove a great saver of time and funds. Weeks and even months are consumed merely to reach mountain peaks where no airplane would dare come down, and yet where a blimp could negotiate a landing with comparative ease. If this is true of certain government services it applies equally well to commercial enterprises faced with similar problems of exploration and communication. In all such activities, and even in such diverse fields as sheep ranching and commercial fisheries, the blimp's ability to go slowly and observe, will one day find its use.

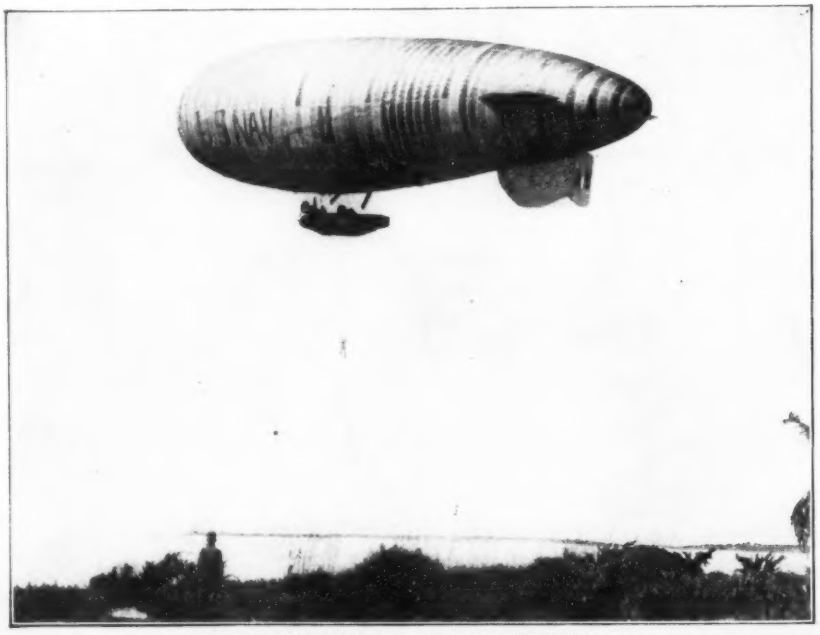
There is also the safety factor to be considered, for the blimp, inflated with helium, cannot explode and it need never crash. Owing to the fact that it is small and has no rigid frame it is in no danger of buckling or bursting from internal stress. At a pinch it can land anywhere, without regard to topography or space, and while it may, if not housed, be subsequently blown away and destroyed, the crew will at least have an excellent chance to escape. Its slower speed makes it less likely than the plane to run into a mountainside in the fog, and even if it does so the danger to life and limb is tremendously less.

ONE of the early blimps collided at full speed with the side of a tall building in New York, bounced off and proceeded on its way! And even though the blimp should stop dead in the air it will not slip or spin. Lightning and the risk of being blown out to sea or into the wilderness without sufficient fuel appear to be the only serious dangers it must face.

To those who saw the British naval blimps on patrol day after day in all kinds of weather, skimming the surface, hovering motionless to mark the location of a sunken ship, or flying high in the blue against a wild westerly gale, the statement that they are not "practical" is no less than absurd. What more severe practical test could be devised than they met then? If they could do those things 10 years ago, they can do others today which would be useful in times of peace.

A SMALL craft capable of carrying three persons 340 miles through the atmosphere at a sustained speed of 46 miles per hour, of drifting with a fair wind or bucking a head wind, of remaining motionless above a given spot for purposes of observation or communication, of rising and descending in a very small space and, finally, of landing or taking off on terrain where an airplane would be wrecked, has potentialities not to be dismissed lightly.

We Americans are a headstrong race of speed worshipers, yet we must admit that it would be folly to hitch a race horse to a plow. Similarly, travel and commercial transportation does not always mean getting to a destination in the shortest possible time. The airplane is a frantic, rocket-like sort of conveyance, marvelous for rapid transit but admittedly lacking in repose. Where it fails, the blimp excels, and vice versa. It really seems as if the two were designed to supplement each other, but man so far has been singularly blind to the uses of one —the slow but sure "Old Rubber Cow."



AN OLD-TIMER MAKES A RESCUE

By means of a hanging rope ladder, an aviator is picked up from terrain where it is impossible to land an airplane to effect a rescue. To do this, the blimp did not have to land

What the World Owes to South Africa

Not Only the Fruits and Grains and Flowering Plants, But the Birds and the Mammals, Including Man Himself, Are Believed to Have Evolved in South Africa

By R. BROOM, M.D., D.Sc.
Fellow of the Royal Society
Late Professor of Geology and Zoology at Victoria College, Stellenbosch, South Africa

MOST people consider that the world is indebted to South Africa only for diamonds and gold, but I wish to show that the debt it owes is far greater. Not only was South Africa the home of the origin of all the higher animals and plants, but there is good reason to believe that it may also have been the home of the first man.

At the end of the Coal Period the whole world had only primitive types of animals and plants. In both the northern and southern hemispheres the only land animals were large and small salamander-like forms, and the plants were mainly gigantic horsetails and club-mosses, with ferns and what are called seed ferns, and a few primitive pine-like trees.

About this time the lands of the southern hemisphere became divided from those of the north by sea, and formed a huge continent which included most of what today is Africa, South America, and part of India and Australia. Doubtless most of the south Atlantic and the Indian Oceans were then land and also formed part of that continent. This great continent is called "Gondwanaland."

For a time much of Gondwanaland was covered by ice; but soon after the end of the Coal Period, temperate and even tropical conditions prevailed and new types of animals and plants began to make their appearance.

In South Africa we are fortunate in having a most wonderful record of the progress of evolution during the five or ten millions of years that followed the Coal Period. We have an uninterrupted succession of shales which by their fossils reveal to us better than in any other part of the world, the evolution of animals for long periods of time. Examining the layers of the shale is like turning over the pages of a book of history. The lower layers show us the life of the earlier times—the upper layers, as deposited, of the later.

The lower shales are not very rich in animal life, but are interesting in showing us a peculiar little fresh water, lizard-like animal which also inhabited Brazil.

A little later we find a very rich fauna with the huge pareiasaurs—those hippopotamus-like reptiles familiar to all students of geology from the figures in the textbooks, and with the pareiasaurs were large carnivorous reptiles that doubtless preyed upon them. Some of these carnivorous types were 15 feet in length.

With these large reptiles were others much smaller, and interesting not only in being much like the warm blooded mammals of today but in being, there can be no doubt, the ancestors of the higher forms of today. Many of these mammal-like reptiles had teeth arranged like the teeth of the dog, with large eye-teeth, and they had the same number of joints in their fingers and toes that man has today. They walked about with their bodies off the ground and no longer crawled like the salamanders, and there is reason to believe that it was this change of habit that started the evolution which resulted in the warm-blooded mammals. The scaly skin became soft and the scales developed into hairs; and the increased activity that became possible gave rise to the higher forms.

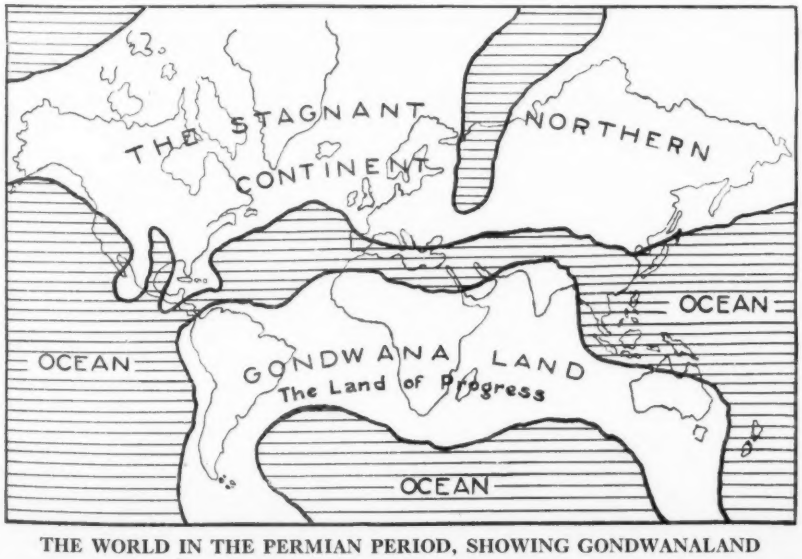
In the shales of South Africa we have hundreds of different mammal-like reptiles—primitive types in the lower beds, and in the upper layers the remains of animals so like the mammals of today that it is not always possible to be quite sure whether they were cold blooded or warm like true mammals.

THE shales not only give us the history of the evolution of the mammals, but show us the stages in the development of the lizards and crocodiles. They also have revealed to us how the dinosaurs arose, and have given us some clues to the origin of birds. When the beds have been more fully studied we will probably have all the steps we could desire in the evolution of these many higher types of life.

The interesting point is that in

Whence the Mammal?

IN the accompanying article Dr. Broom writes of one of the most fascinating and significant phases of earth history, the ancient times when warm-blooded mammals, including our own direct ancestors, were evolving from the reptiles. Readers who wish to pursue this subject further will find much information in Lull's "Organic Evolution;" also in Osborn's "Origin and Evolution of Life." Pirsson and Schuchert's "Textbook of Geology" is also recommended.—*The Editor.*

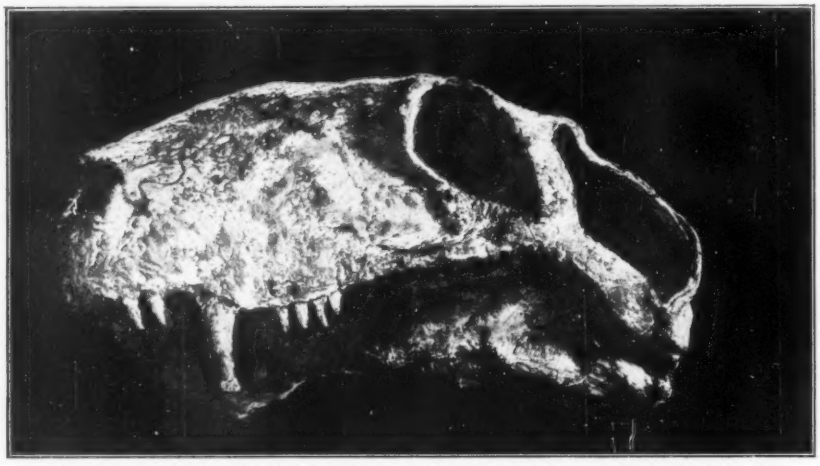


THE WORLD IN THE PERMIAN PERIOD, SHOWING GONDWANALAND

To the student of evolution the fossils found in the rocks of the Permian Period are of vast significance. At that time, in South Africa, the evolution of the first mammals occurred

Gondwanaland there was a wonderful blossoming of higher types of life, and this at a time when there was little or no evolution taking place in the north. During the whole of the Permian Period—that is for some millions of years after the close of the Coal Period—the old types of life continued in the north with only slight modifications, and in all the textbooks of geology the Permian Period will be found placed beside the Coal Period as part of the Paleozoic age or the "age of ancient life."

The Mesozoic age or "age of reptiles" begins, as is shown in the text books, with the next period, the Triassic. The reason for this is that in the Triassic we find appearing in the northern lands large numbers of new types of animals and plants. The whole northern hemisphere becomes transformed. The old forms die out and new forms suddenly take their places. One can almost forgive the early geologists for believing that the Triassic represented a new day in creation.



SKULL OF ONE OF THE SOUTH AFRICAN MAMMAL-LIKE REPTILES

For the first time in known evolutionary history the teeth of these advanced types of reptiles had become specialized as molars, canines, and incisors. This was a significant step

Of course it was no new creation. It was merely the result of a portion of the dividing sea becoming land and the new types of animals and plants that had been evolving in Gondwanaland overflowing into the northern lands and "civilizing" them. Almost all the wonderful new types of animals and plants that have been discovered in the Triassic rocks of the north are now known to be related to somewhat similar forms that lived many years before in Gondwanaland.

AND then, Gondwanaland again became cut off from the north, and the north was left to do what it could with the southern animals and plants. For some millions of years during most of the age of reptiles—the Jurassic Period and much of the Cretaceous—there was no connection with the south. Crocodiles, dinosaurs, and turtles abounded, with a few primitive mammals and a very few birds. They were modified slightly, but not improved. The plants were mainly cycads or sago palms, maidenhair trees and primitive pines, but no flowering plants, and for thousands of years there was no progress.

Then suddenly, in the Cretaceous Period, a great change takes place. Flowering plants of great variety appear. Where they came from no one knows. Darwin years ago suggested that they had been evolving in the south and suddenly were admitted into the northern lands. There can be little doubt that that is what happened, although we cannot prove it. We do know that the flowering plants did not evolve in the north, and although we have no direct evidence, we are justified in concluding that the evolution of the flowering plants occurred in Gondwanaland.

When the new types came into the north there was again a complete revolution, and this time a far greater one than occurred in the Triassic. The clothing of the land with grass probably resulted in a great change in the composition of the atmosphere. In the Cretaceous Period we seem to find in all animal groups evidence of some great struggle. The dinosaurs that during the Jurassic and early Cretaceous times were gracefully built animals, begin in the upper or later Cretaceous Period to take on the most fantastic shapes. Great plates of bone developed around the heads of such forms as triceratops—plates too thin to have been of any use as means of defence. In some reptiles horns were developed; or large spines. Anyone wandering around the dinosaur collection of the American Museum in New York, or other large museums of natural history, will see some of the wonderful developments that took place during this period of struggle. Even the shells in the sea seem to have been affected. The ammonites became strangely coiled; some even became completely uncoiled. The oysters became enormously thickened.

But soon all the struggles appear to have been in vain. The dinosaurs die out and with them disappear the plesiorsaurs, the ichthyosaurs, and the pterodactyls. And in the sea, the ammonites disappear and are never again met with.

With the flowering plants from Gondwanaland there probably came into the northern lands new types of mammals. The few mammals that lived in the north before the middle Cretaceous Period were probably all egg-laying forms like the platypus of today. But with the flowering plants, there probably came into the north from Gondwanaland mammals of a higher type such as insectivores allied to the moles and shrews, and marsupials allied to the opossums.

And then at last Gondwanaland's work was nearly done. The north now was able to carry on the evolution. Most of the mammalian groups we have today evolved in the north—the cattle, the horses, dogs and cats, rabbits and mice, monkeys and bats.

And yet Africa may have rendered one other great service to the world. There is considerable reason to believe that Africa gave to the world its greatest prize—man.

THERE has been great difference of opinion as to where man originated. Monboddo believed that man originated in Africa, and so did Darwin. The discovery of the ape-like man, *Pithecanthropus*, in Java swung opinion around in favor of Asia as having been the ancestral home. The discovery of the jaws of the anthropoid ape *Dryopithecus* in India seemed to confirm this view. To-day Osborn, Matthew, and many others are in favor of Asia as having been the ancestral home. Elliot Smith of London believes that Africa was probably the home, and I who live in South Africa am "patriotic" enough to side with Elliot Smith. In favor of Africa it must be admitted that the two anthropoid apes which come nearest to man, the chimpanzee and gorilla, are to-day living in Africa, and the only other living anthropoid apes which live in Asia, the orang and gibbon, are considerably farther removed from the human stem.

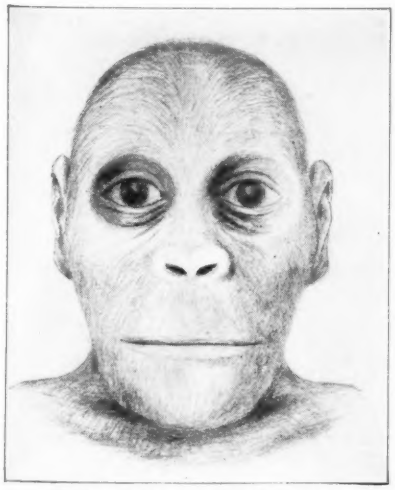
There is a point which is not usually accentuated as I think it ought to be, namely that, in man, the gorilla, and the chimpanzee there are only eight bones in the wrist, but in all the other apes there are nine. The gorilla and the chimpanzee have usually been re-

garded as somewhat removed from the human line through their more arboreal-like habits and their tendency to walk on all fours, resulting in a less man-like foot and a less erect attitude. It has long seemed to me that if we had a gorilla-like ape which had become less specialized for living in forests but had taken to living among the rocks or on the plains and running more on its hind feet, we would have all we could desire as a starting point for man. And just three years ago such a form was discovered in South Africa.

Professor Dart in 1925 startled the world by his announcement of the discovery of the skull of a small man-like ape which he called *Australopithecus*. The skull was found fossilised in a lime-stone cave at Taungs, near the western border of the Transvaal. The exact age of the deposit can not be determined. In my opinion it must be very old, probably either Pliocene or Pleistocene, but if Pleistocene, pretty certainly early Pleistocene.

The skull is that of a quite young animal, comparable in age to a human child of five or six years, and it is consequently a little difficult to restore completely his appearance as it probably would be in adult life. Dart has given a preliminary account of the discovery, one or two other scientists have also examined the skull, and some others who have not seen it, have given their opinions from the study of the casts.

It is admitted by all that the *Australopithecus* is allied to the chimpanzee, but there are many points in



THE TAUNGS "CHILD" APE
An original restoration by the author. No living ape is so manlike as this one was

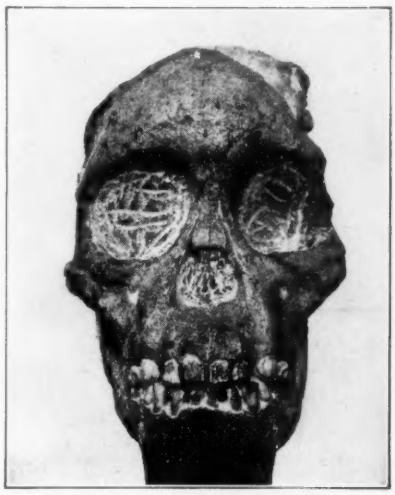
which it differs from the chimpanzee. The milk teeth differ entirely from those of the chimpanzee and gorilla, and agree very closely with those of man. The brain is of the human shape and shows certain very marked advances in the human direction, from the brain of the chimpanzee or gorilla. The bones of the temporal region are also much more like those of man than of either of the other anthropoids. Dart has shown further that the head must have been poised much more erect than the head of either the chimpanzee or gorilla, and thus that *Australopithecus* must have walked more erect. If he walked more erect he must almost certainly have been bipedal. I venture to prophesy that when the hind foot is discovered, it will show that it approaches the foot of man in a surprising way.

There is another most important point. Taungs to-day is in a very dry region, and among the rocks and open forest the only monkeys are baboons and little apes. Associated in the cave where *Australopithecus* was found, are numerous skulls of a species of baboon, sufficiently satisfactory evidence that the climatic conditions when *Australopithecus* lived were very similar to those of to-day, and we can be quite certain that *Australopithecus* was a rock-climbing, plains-living and not a forest-inhabiting animal.

Dart, with the intuition of genius, boldly made *Australopithecus* the type of a new family intermediate between the higher apes and man. This was perhaps a little daring on the evidence, and most of his critics have considered that in this he was wrong. But if when a good skeleton is discovered, as it probably will be in a very few years, it is seen that *Australopithecus* has a foot approaching the human foot, as I believe will be the case, Dart will be thoroughly justified in his conclusions.

ONE much prefers a scientist who will boldly show where he thinks the evidence leads than one who is too cautious to express any opinion. Hrdlicka, the eminent American anthropologist, recently visited South Africa and saw this wonderful skull. He says, "The skull itself is that of an anthropoid ape approaching rather closely in size and form the chimpanzee, but in all probability it is a new species, if not genus, of the great apes. . . . Just what the relation this form bears on the one hand to the human phylum, and on the other to the chimpanzee and gorilla, can only be properly determined after the specimen is well identified, for which are needed additional and adult specimens."

It is interesting to know that in all probability it is a new species. Any paleontologist of experience would have no hesitancy whatever in making it certainly a distinct genus and probably Dart is right in making it the type of a new family. Sollas has shown that the skull differs very greatly from that of the chimpanzee, and concludes that "*Australopithecus* makes a nearer approach to the Hominidae than any existing anthropoid ape." Surely science has advanced sufficiently far to enable one to determine something of the affinities of an anthropoid ape from a single but good skull of even a young individual. It will no doubt be of great importance



THE TAUNGS FOSSIL SKULL
Found in South Africa in 1925. This is one of the best preserved fossil skulls

to have an adult skull which will convince the world and even anthropologists.

One of the two figures which I give represents the front view of the skull as preserved and as most beautifully cleared by Professor Dart. The other is a restoration as the soft parts would appear after taking the bony framework and merely covering it with flesh. The only point in the restoration which is in the slightest doubt is the shape of the nose, of which we have no evidence. I have restored the nose in a form somewhat intermediate between that of a gorilla and chimpanzee. It will be seen that *Australopithecus* is a small human-like ape which no one need be ashamed of having as a forefather.

Certain anthropologists have maintained that *Australopithecus* could not have been a human ancestor because it lived at a time after mankind had probably appeared on the earth. Manifestly, as the specimen died when five or six years old, it could not have been the ancestor of any one, but there is no objection to considering this little specimen as a representative of a race which may have survived hundreds of thousands of years; and that one member of the same tribe, perhaps in early Pliocene times, may have been the ancestor of mankind.

If I am right in claiming that the world owes to South Africa its mammals and its birds, its flowering plants, its fruits and grains, its grass and its blossoms, its cotton and its hemp, and lastly man himself, then to no other country is its debt so great.

PART OF A CITY'S WATER SUPPLY

The O'Shaughnessy Dam as it is at present, creating a beautiful reservoir in a rocky canyon. A highway has been built on its crest; cars and people are visible near its center section

Novel Features of the O'Shaughnessy Dam

Inspection Galleries and Pre-cast Concrete Sections in Large Dam

By C. W. GEIGER

A DAM that will ultimately furnish 400,000,000 gallons of water daily to a community of 4,000,000 people—or 100 gallons daily per person—has just been completed in the Yosemite Valley in California. Named the O'Shaughnessy Dam after the man who built it, this dam is a unit of the gigantic Hetch-Hetchy project which is being developed by the city of San Francisco into one of the most modern water supply systems in the country.

The O'Shaughnessy Dam, as completed at present, rises 226 feet above the stream level but its foundation was designed to support an 86-foot addition which will make its ultimate height 312 feet and its length at crest 900 feet. The present crest is 3727 feet above sea level. The reservoir behind the dam has a capacity of 67 billion gallons of water but when the additional top section is constructed, it will have a capacity of 113 billion gallons, and will then supply daily the amount of water mentioned in the first paragraph. A hydro-electric plant, also to be constructed later, will generate power amounting to 200,000 horsepower for lighting and general industrial purposes.

There are many interesting features in connection with this dam, one of which is the inspection galleries. Interior stairways, leading to the streambed level from the top of the dam, are built into both ends. These stairways are connected by two cross-galleries, one at a point 41 feet below the crest and one at a point 225 feet below the crest. The stairways and galleries allow a thorough inspection of the interior of the dam at any time and give opportunity for observation of the action of the porous drains and contraction joints.

Interior galleries are built on the upstream face of the dam for operating the large slide gates and the 5-foot balanced valves. These galleries are reached through independent ladderways which were cast in the concrete as the structure was built up.

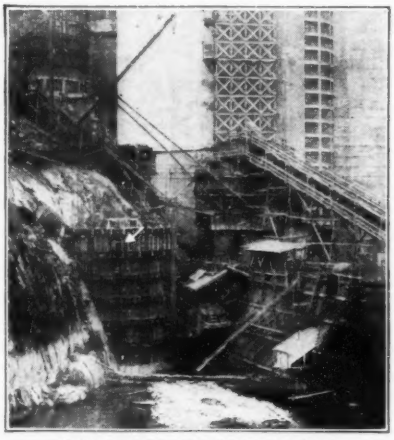
Ladder wells were formed on the contraction joints by forming each half of the well as a block in the block plant, and placing and fitting these on the plane of the joint slightly in advance of the concrete pouring. Porous concrete blocks 3 feet 3 inches square outside measurement and with a 15-inch square cavity, were cast in the block plant and placed near the upstream face, at 12-foot intervals, to form a drainage system.

Three screen racks guarding the entrances to the outlet conduits were built on the face of the dam. These consist of pre-cast reinforced concrete screens supported on reinforced concrete columns and ribs and ranging in height from 60 feet to 112 feet. The screen racks cover all of the openings leading to the valves and serve to prevent any debris reaching and lodging in the valves.

WATER stops made of 1/16-inch sheet copper are used to prevent seepage along the contraction joints. These pieces of copper were bent into a bellows shape and placed in the concrete in sections as the dam was built up, extending from the bottom of the structure to the top. Copper water stops were also placed along the top of the dam to seal the joints between the present crest of the dam and the future extension. The copper water stops have been subjected to the test of a full reservoir and no seepage past them has been observed.

The spillway of the dam consists of 18 siphons, each about 4 feet by 10 feet, and placed in three series at slightly different levels. The siphon openings were formed in the concrete as the structure was built and are heavily reinforced with steel. Each siphon has a capacity of approximately 1000 cubic feet per second. The water discharging from the siphons cataracts down the steps on the back of the dam and forms a waterfall of imposing appearance.

It is the plan, on the final completion of the dam to full height, to bypass the floods through canals and tunnels past one of the abutments of



PRE-CAST TRASH RACKS

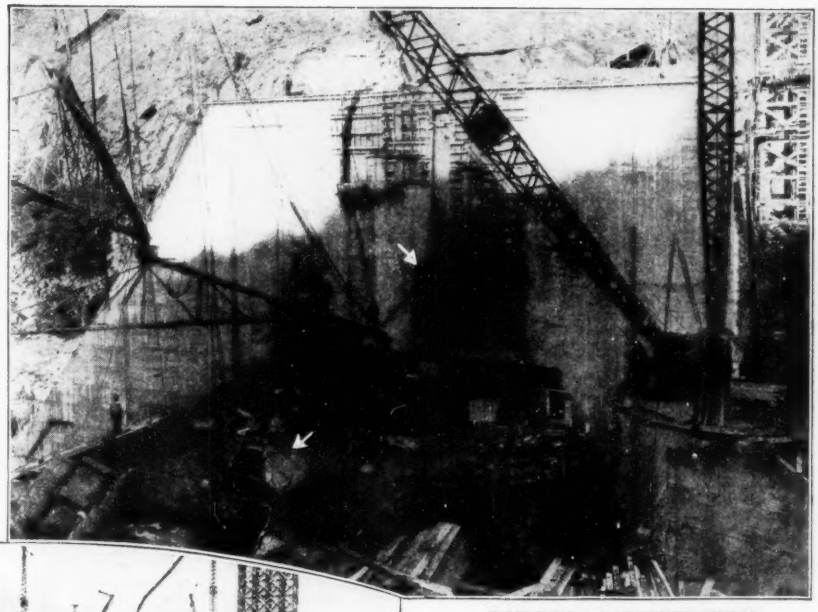
The arrow points to a man who is helping place the pre-cast concrete units

the dam in order to clear the structure altogether.

Valves to control the discharge of water through the dam as required are installed at various levels. Openings, designated as supply pipes, supply wells, and discharge conduits, were cast in the concrete as the structure was built. The valves consist of the following: Six 5-foot balanced needle valves; six 3-foot balanced needle valves; six 47-inch by 90-inch slide gates; and six 33-inch by 42-inch slide gates. The valves and their appurtenances consist of over 2,000,000 pounds of metal.

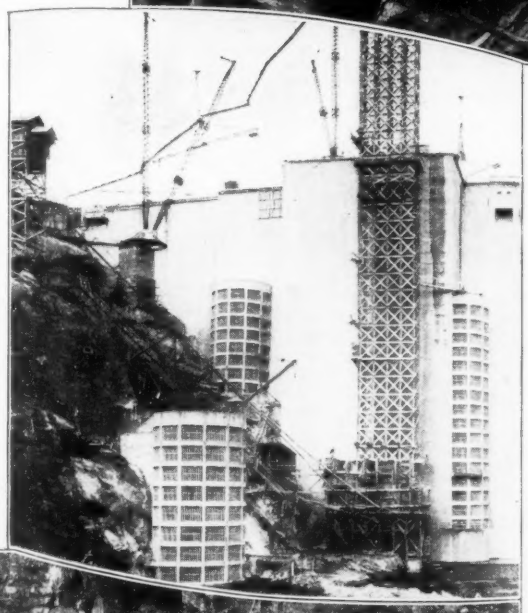
On each opening through the dam there are two controls. The water is admitted through the hydraulically operated slide gate to the supply well and from there the required flow is regulated and discharged by the balanced valve. These valves are of the hydraulically balanced type, which permit manual control of a five-ton plunger under a high head of water.

THE six 5-foot balanced valves and the six 47-inch by 90-inch slide gates are installed in the main portion of the dam, having been encased in the concrete as the structure advanced. Three of the 3-foot balanced valves are installed on the lower side of the dam, 124 feet above base, in a special valve house, and have three 33-inch by 42-inch gates installed in the dam in connection with them. Three 3-foot needle valves and three 33-inch by 42-inch slide gates are installed in the concrete plug in the diversion tunnel and permit draining the reservoir to its lowest levels.



DURING CONSTRUCTION

Arrows point to inspection galleries and ladderways which were cast into the dam as the concrete mix was being poured



THE UPSTREAM FACE

The screens shown here were built up of reinforced concrete columns and ribs, all of which were pre-cast in a block plant

CONSTRUCTION DETAILS

Inspection galleries, the concrete chute, and tie-stones are clearly visible in this view of the central section of the dam under construction: Siphons are being built on top of the stepped section. Concrete is being poured in the center of the huge mass in foreground

The entire upstream face of the dam, below streambed level, was coated to a thickness of 1 inch with mortar applied by a cement gun, and the area above the streambed was coated with mortar to a thickness of three quarters of an inch.

THE 23 to 25-foot diversion tunnel was lined with a 12-inch concrete lining for a distance of 253 feet. On the downstream side of a concrete plug which was constructed in this tunnel, are three of the outlet conduits, with valves and operating chambers to control the discharge from the reservoir.

The shaft leading to the diversion tunnel was cement lined, and two 5-foot by 6-foot ladder wells formed within the shaft to connect with the operating chambers in the tunnel plug.

Concrete lining was placed in an adit, or entrance, to the diversion tunnel and a turbine chamber formed for the 40-horsepower generating plant which furnishes light for the attendants' quarters, and the galleries and roadway of the dam. A shaft 70 feet in depth was sunk through the granite and lined to neat dimensions of 4 feet by 6 feet to give access to the turbine chamber. The top of the dam is finished with a 17-foot roadway, with pre-cast concrete railings.

All illustrations courtesy Bureau of Entomology

METHOD OF PROTECTING HOME GARDENS

Insects which attack the leaves of plants in the small garden can be kept in control by dusting the plants with various chemicals

SPRAYING APPARATUS FOR TRUCK GARDENS

In the truck garden or small field, this one-man spraying outfit will provide an effective means of dusting the plants with poison

Our Crop-Destroying Insect Pests

Man's Struggle With the Insects Becomes Increasingly Intense as We Are Attacked by More Formidable Foes

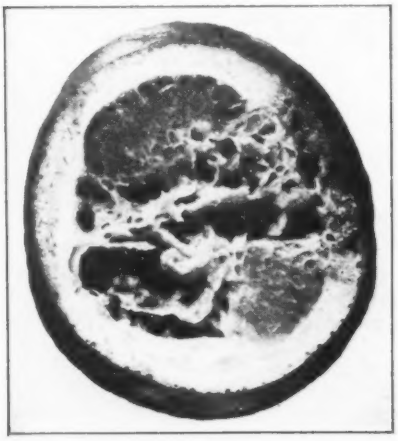
By HENRY W. HOUGH

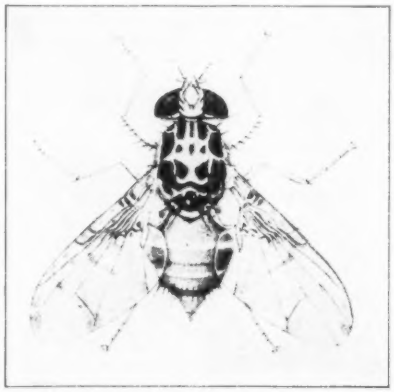
MANKIND is continually harassed by the slow but apparently inexorable onslaught of the countless denizens of the insect kingdom. Our best entomologists agree that we cannot hope to drive out these insidious destroyers of our crops and gardens; the most we can do is to check them—perhaps for but a little while. Too many land-creatures are struggling for possession of the relatively small portion of the earth's surface which rises above the ocean. In regions where the food supply is abundant, the contest is particularly bitter.

We have learned to cultivate the land and make it yield an adequate supply of food; when the crops flourish and become luxuriant, uninvited parasites arrive. Hordes of beetles, flies, and worms appear, often transported great distances on ships, trains, motor trucks, and other man-made conveyances. If the parasites behave like ladies and gentlemen, we make no great effort to drive them away. But when they propagate too profusely, and make pests of themselves by consuming an inordinate portion of our limited food supply, we finally realize that the insects are more than nuisances—they are our enemies.

One tenth of all crop products of the world are destroyed annually by insects, and in the United States we sacrifice to them more than two billion dollars worth of our agricultural products; this includes at least one fifth of our fruit, one fifth of our wheat, and one tenth of our animal products. The problem is not restricted to the fruit grower, the plantation owner, and the rancher; it is shared by every farmer, truck gardener, and home owner. Despite elaborate quarantines and other well-planned attempts to guard our fields and gardens from certain dreaded insects, they have become established in our midst, and assume increasing importance every year.

In view of recent developments, it is interesting to recall a certain little booklet published in 1918 by the





MEDITERRANEAN FRUIT FLY

Above: Adult Mediterranean fruit fly, which has caused the destruction of millions of dollars worth of fruit. *Left:* Grapefruit cut to show damage done by larvae of the fruit fly. *Right:* Sketch showing how a parasite lays its eggs in the larvae of the fruit fly, under certain conditions

Bureau of Entomology of the United States Department of Agriculture, entitled, "The Mediterranean Fruit Fly." It said, in part, "The horticultural development of the Hawaiian Islands has been almost stopped since 1910 by the activity of two fruit-fly pests—the Mediterranean fruit fly and the melon fly. These two pests are being intercepted continually by quarantine officials at our ports of entry and they are therefore feared by, and are of vital interest to, every fruit and vegetable grower in warmer portions of the Pacific and Gulf coast states."

For 11 years more, the hopelessly outnumbered entomologists were able to keep this dreaded marauder from getting a foothold in the United States. But although "every barrier possible" had been erected in an effort to exclude the Mediterranean fruit fly, the task was too great.

IN April of this year, it was discovered in Florida, already well established in the citrus groves surrounding Orlando. Within a week, 75 trained insect fighters and plant experts were on the ground, quarantine zones were established, an appeal was made for a federal appropriation to provide money for meeting the emergency, and in record-breaking time Congress had made available a fund of 4,250,000 dollars for the greatest defensive campaign of its kind yet undertaken by man.

Every orchard in the state was inspected for the pest. Infested zones and protected zones were charted; in every infested area all fruit and produce were destroyed, and in the protected zones all products were subject to examination before being shipped or transported to uninfested regions. The regulations were more rigid than those prescribed when nations go to war, and several companies of the National Guard were called out to aid the 2000 insect specialists who were directing the campaign of destruction and inspection. But before the infestation had been discovered, almost three fourths of Florida's enormous citrus crop had been moved out of the state through normal channels of distribution. The fly was soon found as far west as Texas and Arkansas, and as far north as Ohio and New York, and now every state in the south is menaced.

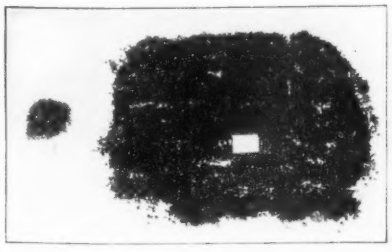
Our famous guest, one of the truly cosmopolitan pests of the earth, is hardly more distinguished looking than an ordinary house fly, for which it might be easily mistaken. The female fly drills holes in the skin of fruits and lays her eggs in the cavity. Within a few days the eggs hatch into wormlike larvae or maggots, which burrow and tunnel through the fruit in all directions, feeding as they go. All the damage to the fruit is done during the larvae stage, which lasts three or four months. Then the immature fly emerges from the fruit, finds shelter on the ground or by burrowing a few inches in the soil, and develops into the pupa or chrysalis from which the full-grown fly emerges to start the routine again.

AN ENEMY MAN HAS NOT DEFEATED

Artist's sketch showing habits of the Japanese beetle. The eggs are deposited in the soil, where the immature beetle feeds on grass roots until it emerges in the fall

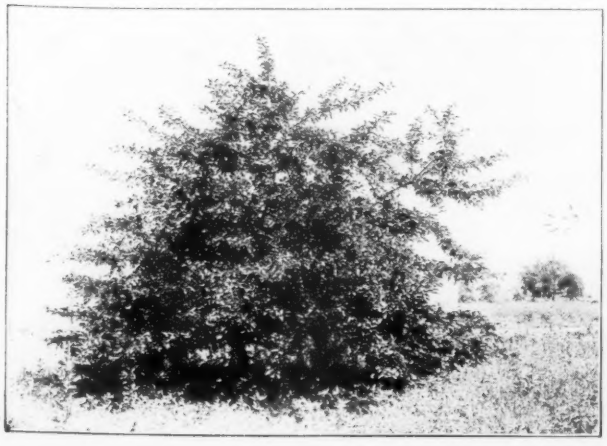
The primary reason for the importance of this particular fruit fly is that it thrives on so many different kinds of growing things, including every common fruit except the pineapple. Watermelons are also immune. It also thrives on many varieties of vegetables, including tomatoes, beans, gourds and egg-plants, and will damage cotton, shrubs, and many species of ornamental trees. For 100 years it has ravaged the warmer agricultural regions of the Old World.

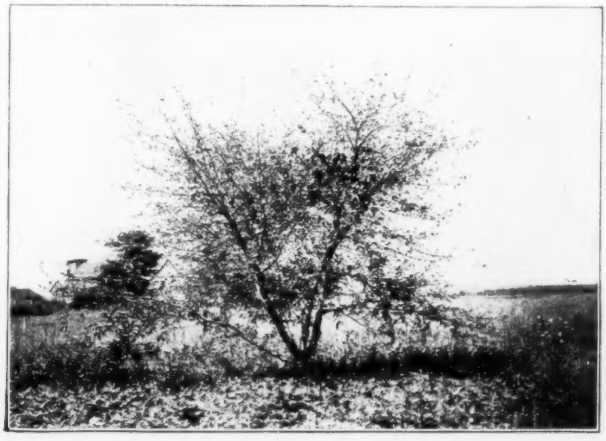
"Clean culture," or the detection, collection, and destruction of all infested fruits, and the elimination of useless or unnecessary host vegetation, is the accepted method of combating the Mediterranean fruit fly. Destroy-

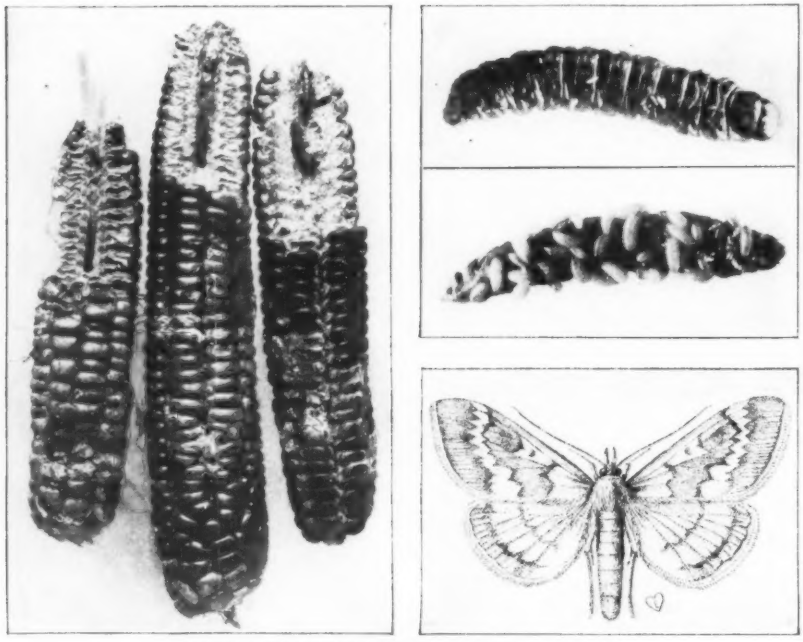


DOES IT PAY TO SPRAY TREES?

The small pile of Japanese beetles was taken from the tree on the left, which had been sprayed; the larger group of beetles was taken from the defoliated tree at the right, which was not sprayed. Several states have been quarantined to retard the spread of these leaf-eating insects







THE EUROPEAN CORN BORER IS HERE

Damage to corn by the European corn borer is shown at the left. This borer attacks more than 200 different kinds of plants, and may do untold damage to important agricultural regions not yet infested. The tiny white specks on the borer at the top of the picture are parasite eggs; the larvae of the parasite are shown in the picture just below, feeding on the paralyzed corn borer. The moth in the illustration is an adult European corn borer (female)

ing many millions of dollars worth of fruit to check the fruit fly seems like killing the dog to get rid of the fleas, but the entomologists know their business. The same tactics were used in checking the hoof and mouth disease in cattle, and in combating the citrus canker in Florida a few years ago.

However, complete eradication is impossible, and a rigorous campaign of clean culture seldom receives the necessary support from fruit growers and farmers, for obvious economic reasons. Under far less favorable conditions the method failed in Hawaii, and recent modifications of the restrictions indicate that a more liberal policy is to be practiced in Florida.

LETTING down the barriers may save from ruin certain fruit growers in the badly infested areas—but we might as well unlock the nation's prisons, or blast the levees that have been erected to prevent Mississippi river floods. In a statement issued to point out that the regulations in the infested region would be liberal in scope, with no intention to annihilate the fruit industry there, Dr. Marlatt of the Bureau of Entomology said, "We would rather let the fly do that."

Although the eggs and larvae of the fruit fly can be effectively destroyed by burning or boiling the fruit, it is also considered important to use poisonous sprays on the trees to kill the adults. Destruction of infested fruits and spraying are remedial measures that should go hand in hand. Natural control, by utilizing parasites and other factors known to be effective in destroying the pest, is unusually difficult in this case. The invader is hardy, and can withstand almost any weather in which fruit can grow, although it is a tropical insect and will become economically important only in the southern portions of the United States. When exposed to direct sunlight, the larvae die rapidly. Certain species of ants eat the larvae, but leave about half of the embryo flies to pupate and mature. Various imported wasp-like parasites have been tried, but are able to reach only the comparative minority of the larvæ which happen to be near the skin of the fruit. About the only hope for effective biological control of the fruit fly is to find pupal or egg parasites, and no satisfactory types have been discovered.

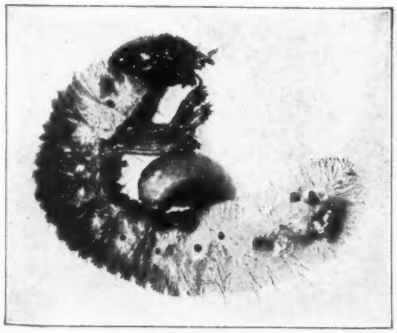
FEW prominent insects have been more successful in a new environment than the Japanese beetle. It is perfectly acclimated, has relatively few natural enemies, and steadily increases its range and the scope of its depredations. In its native land the Japanese beetle is common but not abundant, and is not considered a serious pest. However, since its discovery in this country in 1916, it has become highly important, and is the cause of the present federal quarantine in the states of Connecticut, Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia, and the District of Columbia. The restrictions in force apply to shipments of all farm, garden, and orchard products; grain and forage crops of all kinds; nursery, ornamental, and greenhouse stock and all other plants; and sand, soil, earth, peat, compost, and manure. Although under the surveillance of federal and state entomologists since its discovery near Philadelphia about 13 years ago, it has spread in every direction.

The adult Japanese beetle is practically omnivorous, and is a strong flier; it is gifted with a canny sense of discrimination, which enables it to shun certain poisons after eating enough to get a slight case of indigestion. It is easily trapped, however, and is susceptible to control with the common chemical sprays used against other leaf-eating beetles. As with the Mediterranean fruit fly, the entomologists' attack was directed originally toward complete extermination of the pest. When it became evident that the beetle was not being checked by that practice, various sprays and poisons were found helpful. But even with these checks, the steady spread had continued.

CLIMATOLOGICAL conditions are ideal for the pest. Some of its parasite enemies have been imported but many of them died in the new environment, others were devoured by secondary parasites, and many died of fungus diseases while being shipped from Japan. The Japanese beetles provide a situation any pessimist would enjoy, for they will undoubtedly do more damage every year, over an ever-increasing area.

From Mexico, or perhaps from one of the Central American republics, our cotton growers acquired a prize pest—the cotton boll weevil. About 90 percent of the cotton-producing area of the United States is infested with this pest. It destroys more than 200 million dollars worth of our cotton every year, and farmers have grown so accustomed to it that the damage done by the weevil is seldom mentioned now except when some new area becomes infested.

The adult cotton boll weevil is a



NATURE'S WAR

Drama in the insect world; larvae of the tiphia wasp killing a Japanese beetle grub

peculiar-looking creature, with an elongated proboscis or snout; it is about one fourth of an inch long and a third as wide. During the fruiting season of the cotton, in the spring, the female weevil deposits her eggs in cavities in the squares. About three days later the eggs hatch, and the larvae or grub begins to feed on the plant.

THE weevils breed at an enormous rate, but are held in check to a certain extent by natural factors. Many are killed by cold weather while hibernating during the winter, and during the dry season many of the larvae die from the excessive heat. Many insect parasites prey on this weevil, most of them attacking the eggs in the square or in the cotton boll. Ants eat many of the larvae.

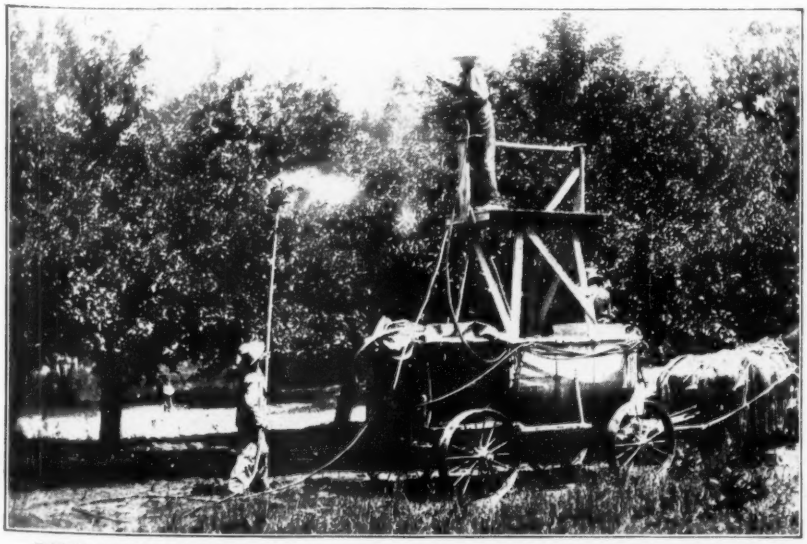
The cotton growers are urged to give careful attention to cultural practices, such as selection of seed, preparation of the soil, and the time of planting. Poisoning the weevil is recommended also, but as a supplementary measure.

One of the most discussed insects in America is the European corn borer, a caterpillar which causes considerable damage to crops in Michigan, Indiana, Ohio, Pennsylvania, New York, Massachusetts, and Maine. It is not yet prevalent in the more important corn producing states, such as Iowa, Nebraska, Kansas, and Missouri. Although primarily a corn insect, this borer has been found on more than 200 different kinds of plants. Due to natural control, it is of little economic importance in Europe, although it is prevalent in certain localities.

The defensive campaign in this country is directed toward a co-operative plan of disposing of all remnants of the corn crop early in the spring, before the borer changes from the caterpillar to the moth stage. Poisons, traps, and putting to pasture fields infested with this insect have little effect in controlling it. Extended studies have been made in an attempt to find native and European parasites of the borer, but the prospects for stimulating natural control of the pest are far from encouraging. The best method to improve the situation in the infested areas is for the growers to co-operate in clean-up campaigns. If, or when, the corn borer spreads to other parts of the United States, the damage it will do will be far more severe than in the regions now affected.

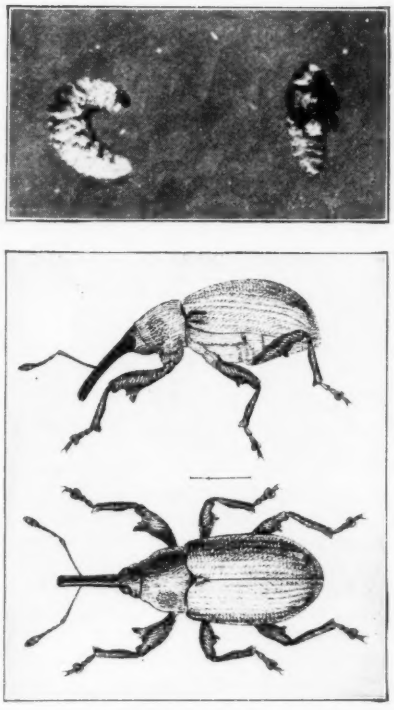
ALTHOUGH the four major crop-destroying pests described above are probably the greatest menace to American agriculture at the present time, there are many other species and varieties of insects which are of considerable economic importance. Among these the most prominent are the coddling moth, gypsy moth, peach moth, alfalfa weevil, pink boll worm, Mexican bean beetle, cattle grubs, and grasshoppers. Many insects exhibit amazing ability to adapt themselves to changed conditions and a new food supply; sometimes an insect infesting crops of one kind will turn its attention to plants of an entirely different nature.

We are beginning to realize that birds are an important factor in controlling insects of many kinds, and are learning more and more about the parasites and diseases to which our important pests are susceptible. In a few instances the airplane had proved helpful in spraying large areas infested with destructive insects and fungi, although in many cases such operations have been of doubtful value.



POWER SPRAY APPARATUS FOR DUSTING FOLIAGE OF LARGE TREES

Although most of the fruit-destroying pests are borers, many of the adult flies and moths can be killed by dusting the foliage of the trees with carefully selected poisonous sprays



MEXICAN COTTON BOLL WEEVIL

The grub of the cotton boll weevil, shown at the top of the illustration, destroys more than 200 million dollars worth of American cotton every year. The long-nosed creature is the adult weevil, highly magnified

While the numerous "parasite zoos" of the world continue to raise and distribute certain deadly enemies of our insect pests, the ordinary gardener will have to rely for some time on the preparations of the insecticide manufacturers. In most cases, these preparations will yield good results, if one follows the directions supplied by the manufacturers. The home owner, gardener, and grower of valuable shrubs, trees and flowers will find in *House Beautiful* for March, 1929, a valuable chart prepared by Mr. C. F. Reeves-Carpenter, entitled, "Controlling Insects and Fungus Diseases." It presents the necessary information concerning types of pests, identification, type of injury, and recommended control measures for caterpillars, beetles, borers, aphids, scale, leaf miners, and fungi.

ALTHOUGH the activities of the Bureau of Entomology of the United States Department of Agriculture are primarily concerned with scientific research, it does much practical work in the field. The bureau employs many specialists who make a thorough study of insects injurious to crops, and who develop practical methods for eradication and control of pests. Led by Dr. C. L. Marlatt and Dr. A. L. Quaintance, the government entomologists are co-operating with state agencies in one of the most difficult undertakings in the history of the race.

What Is Wrong With Men's Clothing

Women's Clothing—Light, Thin, Ventilated, Hygienic—Has Been Rationalized. Men Still Wear Winter Clothing in Summer, and Their Clothing Reduces Their Efficiency All the Time. A Revision Is Due

By DONALD A. LAIRD, Ph.D., Sc.D.
Director, Colgate Psychological Laboratory, Colgate University

CLOTHES make the man in respects more vital than mere appearance and social acceptability. It is true that a slender man looks more stout in a double-breasted coat, or that suiting with a vertical stripe makes the short man look taller. But these are not especially vital factors. Research and scientific opinion are rapidly accumulating data which indicate rather definitely that clothing may almost remake the course of human history.

This newer knowledge helps one understand why we make more mistakes in summer, why usually sensible Germany has a growing number of nude societies, why the Alps are healthful, how to keep cool in summer; and it also makes us pause and wonder about man's place in the decades to come.

White civilization at present is dominated by the male. History records numerous places, however, where women have dominated. Even now the explorers bring back to us reports from remote places where women dominate. This newer knowledge about clothes may make us wonder whether a female dominated civilization lies in the not so distant future.

FOR years it has been known that slightly more boy than girl babies are born. Boy babies are the more delicate, however, and there are more early deaths among them. By the time high school age is reached the ratio has been altered so that there is an excess of females. As years go on, this ratio is changed still more, industrial accidents eliminating more men than women; disease also reduces the number of men more than it affects women.

Total numbers alone will not necessarily determine which sex will dominate. We see a small handful of Englishmen dominating dark-skinned India. Vitality and ability are fully as significant as mere numbers. And on this point, also, modern science would point to a change to a dominance by the so-called gentler sex.

His Majesty's medical inspectors have just reported on thorough studies of English boys and girls who are entering industry. They report definitely that the girls are much better developed physically than the boys. It has been known for many years that although women do not usually have the muscular strength of men, they are in the long run possessed of greater physical stamina and resistance. The royal medical inspectors are inclined to attribute a large amount of this difference to the clothing which is being worn.

It is only in the last two decades that women's clothing has differed essentially from that of man; and the puny, almost neurasthenic, women typical of the 80's seem largely to have disappeared, along with the disappearance of several square yards of woolen clothing per woman.

Fifteen pounds of clothing was the average worn by men a few years ago, and women wore "a little more," according to the books. Men are still wearing about the same gross tonnage of clothes as ever, while women's clothes have only about one tenth of their former weight. This means that men are still wearing about a tenth of their body weight in clothes, while a dog, which seems to stand cold weather remarkably well, carries only about one fiftieth of his weight in fur.

Man has to pay a price for this extra weight in several unusual ways. Energy has to be used, for example, to carry the extra weight around, even though the energy is not consumed in useful or productive work. This excess clothing worn by men also results in men living in a self-produced tropical climate in both summer and winter within their clothing, while women live in the atmosphere of the Alps. Tropical climates are enervating; the Alpine atmosphere is invigorating. The temperature within the clothing of the average man is 87.8 degrees, Fahrenheit; for women's clothing it is only 80.6 degrees. The relative humidity inside men's clothing is 70 percent, and for women it is only 55 percent. The observed consequence is that men suffer from heat stasis and from excessive perspiration.

A miracle of nature is the way in

A TEST THAT TELLS—ON THE MAN

When we inspect the clothes worn by dancing marathoners do we wonder that a woman dancer will wear out two or three partners? We are not all dancing marathoners, but—

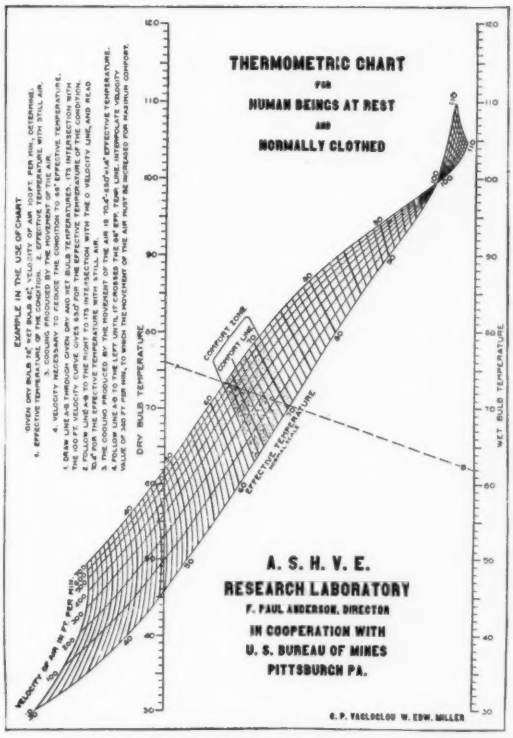
which the human body is kept at a uniform temperature, almost regardless of the external temperature in which it is placed. Any marked change in the external temperature throws additional work on the heat regulating mechanism and the metabolism of almost every cell of the body. Our bodies have continually to radiate heat in order to keep their temperature at the healthful constant of 96.8 degrees, Fahrenheit. When, however, the environment has a higher temperature and a higher humidity, and the air circulation is diminished by the clothing, the body cooling function is hampered. Thus, regardless of the room temperature, men's bodily mechanisms have more difficulty in keeping the body temperature at nature's point, due to the secondary air environment within the kind of clothing they wear.

THUS the basal metabolism is lowered, a load which may reach dangerous proportions is thrown on the sweat glands, and this affects the water distribution in the body and may influence the kidneys and other vital organs.

These statements are not based simply upon scientific logic, although the logic is plain. These effects have been observed by such men as Dr. E. S. Sundstroem of the University of California, who has studied not only the white population of Queensland, Australia, but also more than 700 white rats in specially equipped rooms where temperatures and humidities could be produced at will. Dr. Leonard Hill, the eminent English physiologist, has also noted these conditions and is urging radical changes in the clothing of men. Dr. E. Friedberger of the University of Griefswald recently presented the conclusions of a long study of clothing at the Berliner Gesellschaft für öffentliche Gesundheitspflege, which were essentially the same as outlined in this article.

How well sunlight could reach the bodies of men and women was given special emphasis by Herr Doctor Professor Friedberger. Using strips of paper which were sensitive to light he discovered that much light reached the body surface of clothed women, but that the sun's rays do not penetrate men's ordinary clothing. Part of them will penetrate a shirt, but if it is covered with a coat, practically no light reaches the surface of the body.

The admission of air is of perhaps equal importance with that of vitalizing light rays, and in this case, also, the clothing of men extracts a penalty.



TEMPERATURE-HUMIDITY RELATIONS
Data worked out by the American Society of Heating and Ventilating Engineers and the Bureau of Mines

Ultra-violet light penetration through ordinary clothing materials has been studied intensively by the Bureau of Standards of the Department of Commerce. They find that rayon, batiste or nainsook cotton, and linen allow more of these rays to pass through than do pure silk or wool. When the materials are dyed or slightly yellowish with age, the passage of the ultra-violet is cut down. Woolen is only about half as transparent to these rays as is white cotton. The weave of clothing greatly affects its transmitting power. Crocheted or knitted weaves allow the most light, and also air, to bring their benefits to the surface of the body.

A COOL, QUIET DINING ROOM
This home at Urbana, Illinois, is equipped with walls and ceilings which insulate against heat and noise

Better than an overdose of ultra-violet, as on the seashore with its annoying first day sunburn, is a continual mild exposure, such as would be given by the correct selection of clothing. Much of the benefit from resting at the seashore comes from the ultra-violet baths taken on the beach, although this should not be overdone the first few days. Other advantages which make people erroneously think that sea air is intrinsically bracing, come from the breezes which unburden the heat-regulating machinery of the body by removing the layers of stagnant air between body surface and outer clothing. Lounging at the shore in a wet bathing suit throws too much strain on the heating plant, however.

Perspiring in hot weather is a good way to keep cool, since each quart of perspiration means that the body has been relieved of about 500 calories. However, a few people do not perspire. These unfortunate few should drink hot beverages in warm weather, since extra perspiration is induced by the hot liquid. Everyone drinks more during hot weather, and adding just a pinch of ordinary table salt to the water is helpful since it replenishes the abnormally high loss of salt from the body during summer perspiring.

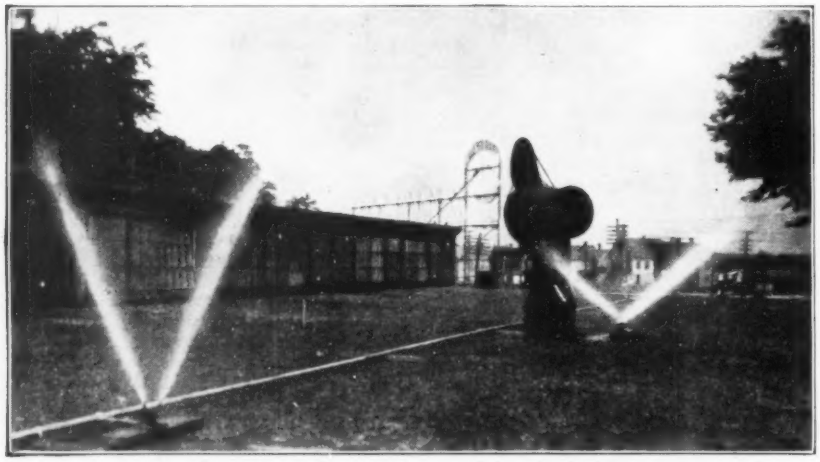
THOMAS A. EDISON always has a fan with him in hot weather. You may never have seen it in his photographs, but it is always there. His loose clothing also amounts to a fan, since it allows minute air currents to displace the overheated air near the body surface. On an especially hot day the best way to keep cool is to keep the windows closed to prevent hot outside air from entering; to pull the shades to keep out the heating sun rays; to turn on an electric fan; to keep calm; and to wear loose clothing.

Food should also come into consideration. Proteins should be reduced and carbohydrates increased. Fruits, salads, green vegetables, rice, fish in

moderation, fowl, and dairy produce are best.

Men will also be cooler in summer if they wear suspenders rather than a belt. However, since they should also go without a coat they may feel conspicuous if wearing suspenders. This dilemma is easily solved by wearing hidden suspenders and a very loose belt. The belt adds to one's discomfort, not especially because it binds the blood vessels, but rather because it stops the circulation of air within the clothing. Tightly fitting garters do hamper the blood stream, as well as quantities of blood to the brain. "Whenever you suffer from headache," said Dr. Royal S. Copeland, "my advice to you is to loosen the collar." In addition to constricting the circulation of the blood the tight, stiff collar prevents the free circulation of cooling or refreshing air currents over the surface of the body. Tight pajama belts affect only the circulation, but that is enough to bring them into court.

The collar, garter, long underwear, and lined clothing result in only the face and hands of men being exposed to the sun and air. In the case of



FIGHTING THE DETRIMENTAL EFFECTS OF CLOTHES

The Dennison Manufacturing Company makes the wearing of clothes less uncomfortable in summer by spraying the roofs of the buildings, cooling directly and by evaporation

quickly becoming unsanitary themselves. A good grade of men's hose does not need garters to keep it looking trim. If supporters are necessary, because of thin calves, preference should be given to those which clamp to the shirt and do not constrict the leg, and which, incidentally, keep the shirt trim and secure when the coat is sensibly left off.

VENTILATED oxfords are unusually comfortable. I have worn them for years during warm weather, but have had great difficulty obtaining them in the last year or two since they seem to have gone out of fashion. I have been able to obtain them lately only from left-over and shopworn stock several seasons old. I have been told this spring that they will have to be made to order at a rather high price.

Since constriction is an important item against the garter, the same consideration should annihilate the tight fitting starched collar entirely. Collar manufactures have been having trouble finding a market, lately. Perhaps men are at last rationally revolting against this last remnant of the corset which was originated as a protection against lance and sword thrusts. The blood vessels in the neck are large but are limited to a small area. They are important vessels which carry great women, fully one third of the body surface is exposed more or less to sunlight and ultra-violet, while practically her entire body surface is continuously ventilated by air currents. She is much better, physically and mentally, for this. So we find Dr. Ephraim R. Mulford, president of the New Jersey Medical Society, saying: "To-day our American women are in better physical condition than our men." It was only a few decades ago that Mary Walker agitated for womens' suffrage and created a sensation when she insisted also upon the right to wear men's clothes. She may have been right about the ballot, but she was dead wrong about the clothes.

There is also the matter of cleansing clothes. In this, women again have the advantage, their light garments and underclothing being readily and frequently washed at home. It is far from a luxury for a man to invest in enough hosiery and underclothing to allow a fresh change each day. Shirts should be allowed to air alternate days. Clothes closets should be provided with ventilators which allow outside air to enter, keeping the clothing in a more sanitary condition as well as making life a bit more miserable for moths.

Why people started to wear clothes has puzzled science for a long time. Some think wearing clothes was started by women who wanted to make themselves more attractive. Whether or not this is the explanation, it is true that this tells us much about why they wear the particular clothes they do. Another theory advanced to explain the beginning of clothes was that they were adopted to keep the wearer warm. Still another theory is that clothes were adopted because people began to feel immodest about their nudity. This is difficult to accept because among isolated tropical peoples where no clothing is worn it is considered immodest to hide the body; the general principle is that any sudden change in the kind of clothing worn is considered immodest, and it is certain that, if immodesty means attracting unwarranted attention through dress, a sudden change would cause such a reaction. Another theory, recently advanced by Dr. Knight Dunlap, the psychologist, is that clothes originated in tropical regions and were shreds or rushes which served the purpose of driving flies away.

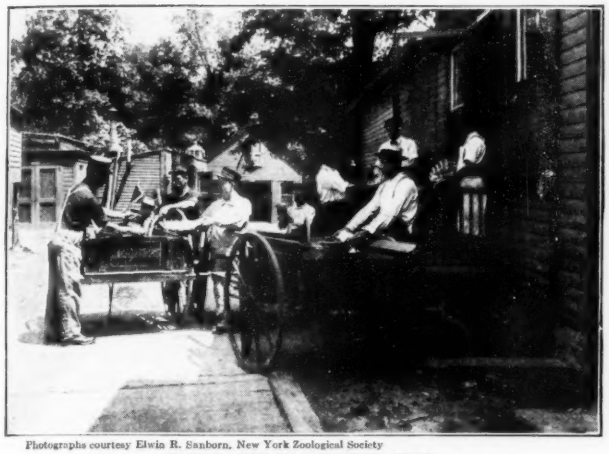
Whatever the origin of clothes we can agree with Langdon-Davies who has just said "the fact that we value people by their clothes, judge them by their clothes, fall in love with them by their clothes, means that all sorts of unfortunate results might happen if our standard of judgment, the cynosure of the eye, suddenly disappeared."

Regardless of how clothes originated or what would happen if they were suddenly redesigned, we should heed the warning provided by scientific research which indicates that clothes may ruin man unless fickle fashion or common sense bring about a change.

WOMEN are just as intelligent as men, and are capable of doing the work of an industrial executive, as great numbers of them have shown. With their equal brain power, their dress, which adds to their mental and physical efficiency, may give them an increasing advantage over men in directing our civilization.

"By 1975," says Dr. Walter B. Pitkin, in discussing the decline of the American mind, "the present supersalesman and high-powered executive will have gone. Some quiet spinster with a world radio telephone at her elbow and an automatic statistical computer in her office will handle more big business in a morning hour than such gentlemen get through in a week of golf and highballs at their country clubs."

¶ *The old question, "What becomes of all the pins?" is paralleled by the question "What ultimately becomes of all the light that goes out into interstellar space?" Next month this will be the interesting subject of Professor Henry Norris Russell's article on astronomy. It should interest you.*



Photographs courtesy Elwin R. Sanborn, New York Zoological Society

MEAL TIME AT THE ZOO

The commissary department of a great zoo issuing rations which will be taken by keepers to animals in widely separated buildings

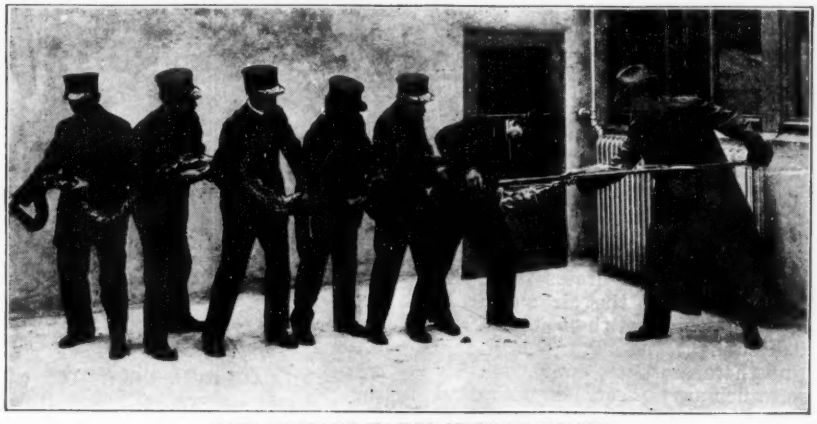
FOOD FOR NON-PAYING GUESTS

Palates differ widely in the animal world. Rich foods in a great variety are in this zoo kitchen which looks like that of a hotel

Catering for the Denizens of the "Zoo"

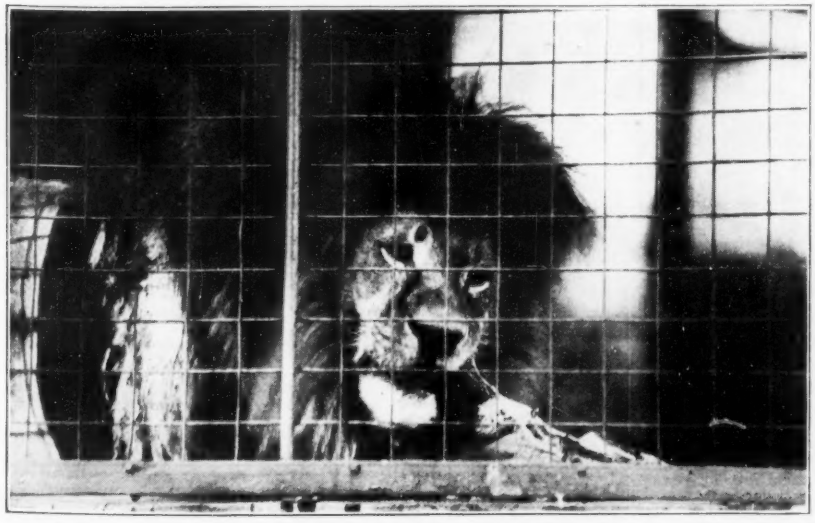
NEARLY 50,000 dollars a year is the total butcher, grocer, green grocer, and fish bill for the 3000 living creatures in the New York Zoological Park. The kitchens are out of the beaten track. At certain times of the day a peculiar type of push cart starts out on the journey to the widely separated animal and bird houses and its arrival is apt to be received with audible marks of delight. Through the service roads come the supplies to the commissary department.

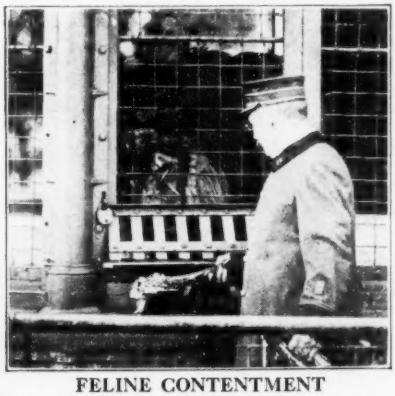
The mammals require daily: 250 pounds of beef, 50 pounds of fish, 175 loaves of bread, 1 ton of hay, 15 bushels of grain, 100 heads of cabbage, 450 bananas, 150 apples, 50 oranges, and 25 quarts of milk. This is not all, but the full list would tire. Some of the big snakes are content with a quick lunch every three or four weeks. A small pig is a delightful morsel but is rather distending for the first three days. The rarer the animal, the more expensive the diet. The short-lived duck-billed platipus used to consume over $4.50 worth of meal worms and shrimps every day. Even this did not keep away the grim reaper. Everybody and everything eats in the Zoo and there is never any talk of the high cost of provisions.



THE PYTHON TAKES NOURISHMENT

Sometimes a python or a boa constrictor is forcibly fed. Then there *is* a circus. There is about as much fun holding a large, slippery snake of this kind as in holding a fire hose





FELINE CONTENTMENT

A 12-pound piece of beef is enough for a lion in a cage but a generous quantity of cod-liver oil for dessert is a poor substitute for what he'd probably get were he in the jungle. Lions are not fed horse meat as many people think. It is entirely too expensive even for His Majesty

Fungi That Kill

Certain Fungus Forms of Life Attack and Destroy House Flies, Mosquitoes, Caterpillars, Butterflies, and Fishes

By DR. E. BADE

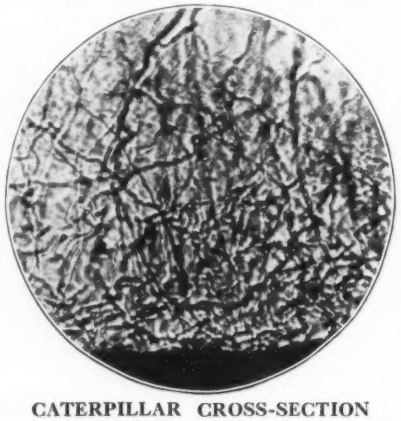
LOWER plant life, first thoroughly studied by means of the microscope, is not far different from the plant life of field and forest. In both types of life, the inconceivably small and the large, there are forms which from man's point of view are either beneficial, injurious, or indifferent.

It is neither wise nor right to consider the minute forms as enemies of the higher plants whose sole duty is their destruction or injury. True, there are a few, a very few forms which are dangerous to man and do become pests, but many more of them are absolutely essential for our civilization.

ALL fungi are parasites, for they take organic material, the carbohydrates, from other organic substances. Usually this is obtained from dead and decaying material. They must do this because they lack chlorophyl, the green coloring matter of plants which enables the possessor to manufacture carbohydrates from the carbon dioxide of the air and from moisture taken from the soil with the aid of sunlight.

But there are some fungi, peculiar ones, which are not satisfied with dead matter; they attack living things, not only plants, but animals as well, robbing them of their life's fluid and causing their destruction. These particular fungi demand certain definite food conditions in order to develop and grow to their greatest vigor. If these conditions are lacking, the fungi do not thrive but just vegetate.

The distribution of terrestrial forms occurs through the air, the spores being carried by the wind. A few are provided with spray devices which hurl the spores in all directions. Such a device is used by the fly killer, *Empusa muscae*. The spores are hurled great distances and when a fly is hit, the spore or conidia, which is surrounded with a glue-like gelatinous mass, remains attached at the place of contact.



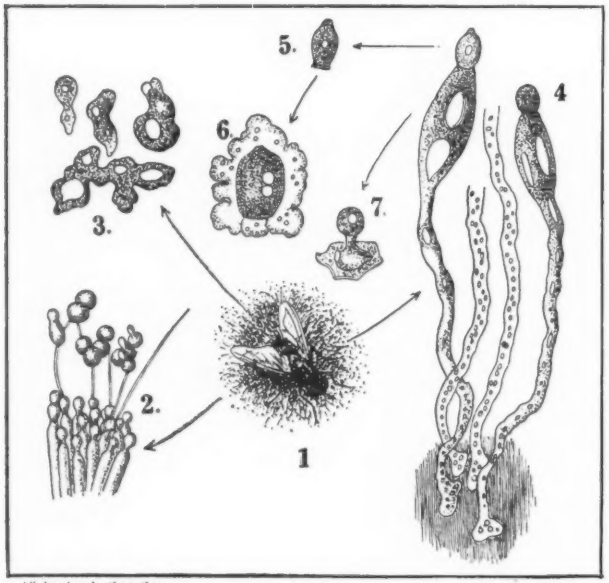
CATERPILLAR CROSS-SECTION

This magnified cross-section through a caterpillar shows infection of fungus

It is now the firm intention of the spore to enter the body of the fly at the first convenient spot. The spore, in order to accomplish this, proceeds to grow a tube which elongates at its tip. This tip feels along the body seeking a breathing pore on the fly's abdomen through which it may easily enter into the body. If the tip does not find the pore, it seeks a weak spot on an abdominal segment and here it pushes through the thin skin.

ONCE the tip has entered, it begins to grow at a tremendous rate, spreading out into all parts of the body. Here short, variously formed segments like those of yeast are produced, which suck out the entire juices of the fly. After the entire body has been filled with the fungus threads, the fruiting bodies of the fungus break through the softer tissue of the abdomen. These produce new spores by the million, sending them out through the air, so that other flies may be infested with this disease.

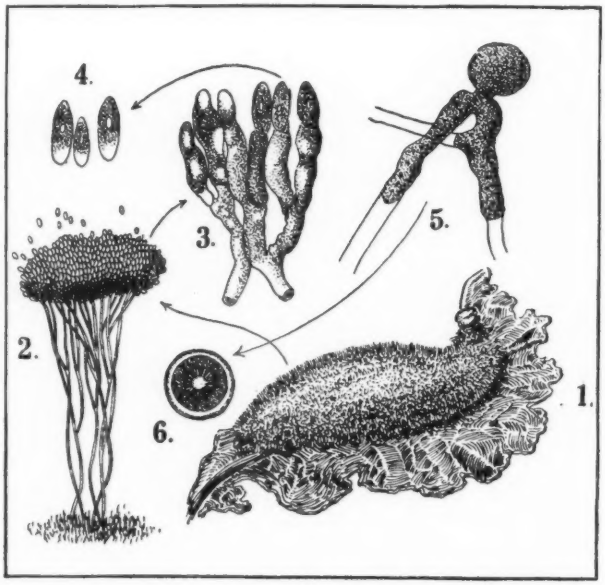
A fly that has once been attacked



All drawings by the author

EMPUSA MUSCA—FUNGUS THAT KILLS FLIES

1: Dead fly, with spores. 2: Fruiting bodies. 3: Vegetative cells. 4: Conidia bearing cells. 5: Conidia hurled into space. 6: Conidia surrounded with ring of glue. 7: Secondary conidia



FUNGUS THAT KILLS CABBAGE BUTTERFLIES

1: Dead caterpillar surrounded with veil of spores. 2: Enlarged spores on back of caterpillar. 3: Divided spore capsules. 4: The conidia. 5: Formation of zygospores. 6: A zygospore

by this fungus, loses its speed and dexterity in flight. Each of its motions seem heavy and painful. It prefers to sit still in one place, motionless, sick. A few days after it is infested it is dead. Then it is surrounded with a white or yellow halo, a halo consisting of ripe spores of the fungus that killed the fly, spores that are ready to attack other flies.

Other similar fungi are always found when certain insects have multiplied to excess through exceptionally favorable conditions. Then the lower fungi produce real epidemics among these insects, killing off the majority. It is under such conditions that the fungus *Entomophthora spaerosperma* attacks the caterpillar of the cabbage butterfly, veiling it in white mold. This fungus develops long threads which extend far out of the body of the caterpillar. The fungi belonging to this group also develop, besides the asexual spores, so called "zygospores" which are formed by the union of thread cells. These preserve the life of the fungus during unfavorable conditions. Such long-lived spores are not produced by the fly killer.

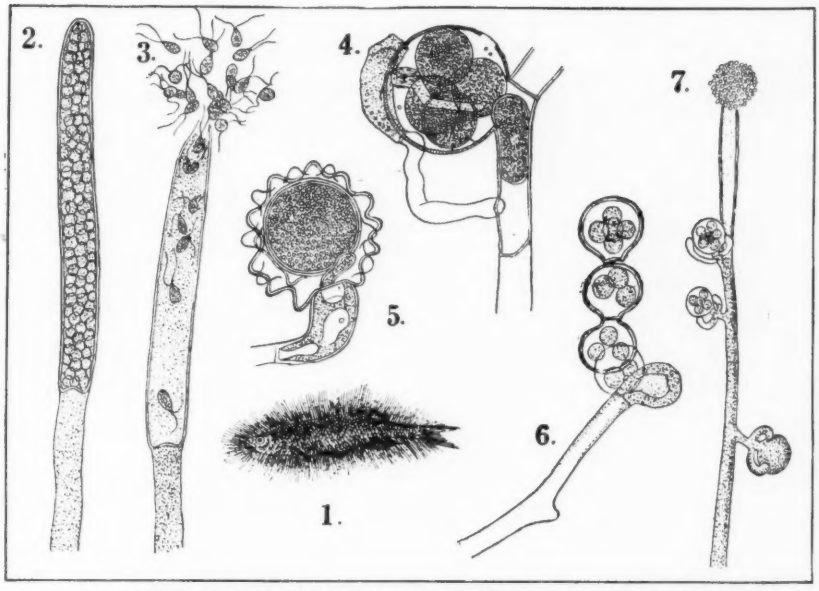
MEMBERS of the species *Lamia* attack mosquitos. This species develops sterile cells between the spore cells which project above them.

The forerunners of today's fungi were probably inhabitants of the water. Such an aquatic fungus group is *Saprolegniineae*, the majority of which attack dead and decaying material. Some of them have become true parasites and they induce some of the more virulent diseases of fish. Such aquatic fungi are always found in all natural waters.

When a fish is attacked by these aquatic fungi the fungus first spreads the length of the fish upon the skin. Then shoots are sent into the sides. From here root-like structures or "holdfasts" are sent into the skin. In this way the fungus lives vegetatively for a time. Later the spores are provided with two small cilia or hairlike members so that they are enabled to swarm freely about in the water. After a time they come to rest, cast off their skin, and are again active. At last they come to rest again and the spore begins to germinate, sending out its tubes. On propagation through conidia or spores, the tips swell to spheres; these break into pieces and germinate on a suitable spot. The third method of propagation occurs through egg cells, the so-called oospores, which are able to withstand unfavorable conditions.

HAIO-TSAO-TON-TSCHONG

This is the "summer-caterpillar-winter-plant" used by the Chinese for medicine



AQUATIC FUNGI IN DIFFERENT STAGES OF THEIR CYCLES

1: Fish killed by *Saprolegnia*. 3: Zoosporangium before swarming. 3: Swarming spores leaving the zoosporangium. These spores swim freely about in the water. 4: The oospore or resting spore. 5: An aquatic fungus attacking water animals. 6 and 7: Aquatic fungi

Especially dangerous for fish are the conidia or spores of *Saprolegnia* which are much branched. If they enter the gills, the fish is almost invariably condemned to death, for the fungus finds the best possible conditions for its growth and development in this position. Usually the aquatic fungi attack only those fish which have become wounded in some manner or other, especially if their skin has been injured. This explains the death of many fishes returned to the water by fishermen, after rough handling.

A FOOT IN LENGTH

A fungus which produces fruiting bodies which extend a foot above the caterpillar

Of the *Pyrenomycetineae* group, the species *Botrytis bassiana* is the most dangerous in the cultivation of the silk worm. The caterpillar attacked becomes sluggish in its movements, stops eating, and usually dies 12 days later. Then it has become mummified. The germinating tubes of the spore penetrate the skin of the caterpillar, divide in the interior, and grow into the muscle and fat bundles where they cut off cylindrical segments. They enter the blood where, by budding, new shoots are developed, which increases the quantity of fungus mycelium or body of the fungus within the caterpillar. This mycelium again leaves or grows out of the dead caterpillar which has become mummified, and covers it with a white veil of colorless fruiting bodies consisting of short clubs containing the spherical tailed conidia.

Similar fungi have been used to control other insects by disease, especially the dangerous (at least to crops) grasshopper, but the experiments have not been especially successful.

THE fungus forms of *Cordyceps*, the club tube fungus, which is especially well represented in the tropics and sub-tropics, produce on the insects they have killed, especially caterpillars, long-fruiting, club-shaped bodies which are brightly colored. The interior of the caterpillar is entirely filled with the fungus mycelium in such a way that the shape of the insect is perfectly preserved. Various forms of this fungus attack beetles, grasshoppers, spiders, caterpillars, the pupa of butterflies, and so on. In a number of foreign forms the clubs may attain a length of 29 or more inches.

The fungus *Cordyceps sinensis*, found in eastern Asia growing upon caterpillars, is considered in China an exceptionally well liked and expensive medicine. The mummified caterpillars are packed in bundles and are brought upon the market under the agglutinated name of "summer-caterpillar-winter-plant" (Hiao-tsao-ton-tschong).

The Truth About Snake Stories*

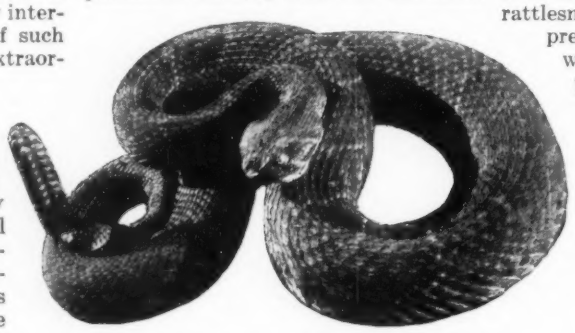
Fish Stories Pale While Snake Stories Hold the Fort, for There Is Usually Not a Word of Truth in Them

By KARL P. SCHMIDT
Assistant Curator of Reptiles, Field Museum of Natural History

THE real truth about snake stories is that they are all too likely to be untrue. The stories popularly believed about snakes are legion, and unquestionably the amount of misinformation current about them greatly exceeds what is actually known to the average man. "Fish stories" as a class are mere exaggerations, while reptile and snake stories are more fanciful or truly mythical elaborations of a smaller foundation of fact. Many of the beliefs about snakes, and about reptiles in general, do have some original basis in observation. When critically examined, however, this modicum of truth may prove to be infinitesimal, or the observable facts may prove to have been wrongly interpreted. The tenacity of life of such misinterpretations is often extraordinary.

IN North America the sovereign remedy for snake bite is whisky, prescribed in large doses. A more extraordinarily wrong procedure could not well be devised. Thorough-going experiments have shown that alcohol in small doses increases the rapidity with which snake poison is absorbed by the body, while in larger doses it very rapidly becomes an active aid to the snake poison, weakening the heart action when it most requires stimulation. The great majority of North American snakes are entirely non-poisonous. Several of the larger species, however—the common black snake and the large water snakes for example—are even more aggressive and more likely to bite than their poisonous brethren, a fact well known to most naturalists from personal experience. Such bites invariably heal promptly, without the slightest local or general symptoms of poisoning. To the great majority of people, however, all snakes are alike poisonous, and whisky has undoubtedly often been administered for the bite of such non-poisonous snakes. The patient, being less likely to die from the whisky alone than from the combination of whisky and snake poison, has a good chance of recovering in such cases. This chain of circumstances forms the foundation of the popular faith in whisky as a remedy for snake bite, although it must also be admitted that the belief is one willingly entertained by many.

The application of scientific research, beginning with the work of Pasteur, has developed the only real specifics against snake poison in the modern anti-venins. By their use, for example, the fatalities from snake poisoning in the Brazilian state of São Paulo have been reduced from the record of 155 in 1907 to two or three in 1924. Unfortunately it has been found that specific anti-venins must be prepared for each species, or at least for each group of related species, of poisonous snakes; and this increases vastly the difficulties of treatment by this means. A North American anti-snake-bite serum has just been put on the market.



TEXAS DIAMOND BACK RATTLESNAKE
An extensive folklore has grown up about rattlesnakes. The text describes many widespread and erroneous beliefs

The most characteristic poisonous snakes of North America are the rattlesnakes, and an extensive folklore has grown up about them. Quite the most common belief about rattlesnakes is that their age may be told by the number of rattles they possess. This is true when the rattle is complete with the original button with which the snake was born, although the number of rattles varies with the amount of food taken by the snake, and certain other conditions, so that the average figure, three rattles per year, is subject to individual fluctuations. A rattle is added every time the skin is shed. When the snake is full grown the rattle is rarely complete. It is widely believed that rattlesnakes when confined, and especially if tortured, will strike themselves and thus commit suicide. All available information, however, indicates that snakes are immune to their own venom, and in experiments I have made personally, causing a rattler to bite himself, there was no visible effect. There is a foundation for the story in that a snake, if sufficiently excited, will lash out in every direction and may then catch his fangs on one of his coils. The blow snake, when going into the convulsion preceding its death-feint, frequently catches its fangs on its own body.

The common belief in the southwest that rattlesnakes will not cross a horse-hair rope (or even a chalk-line!) also seems to be without foundation. One of the widespread beliefs about rattlesnakes in the west concerns their presence in prairie dog colonies, where they are said to live in peace with prairie dogs and burrowing owls. The peacefulness of this relation is certainly open to question, in view of the rattlesnake's fondness for small mammals as an article of diet.

BY far the most characteristic North American rattlesnake fable is an elaboration of the fact that it is possible to be slightly poisoned by the venom in a broken fang. The story goes that a man is bitten by a rattlesnake and duly dies. His infant son grows to manhood and, finding in the attic an old pair of boots which fit him, puts them on and mysteriously dies with the symptoms of snake poisoning. An infant grandson grows up and, finding an old pair of shoes about, puts them on and becomes violently ill, but recovers. Examination of the boots reveals the broken fang of a rattlesnake embedded in the leather. The number of generations in this story varies, but otherwise its general course is the same whether it is told in Florida, Texas, or California. It has recently been embodied in a short story. The amount of poison on the point of a fang is of course so small that fatal results are very unlikely.

In the joint snake story or the glass snake story, we are told of a curious snake which flies into pieces when struck with a stick. The pieces are said to reunite if one leaves them un-

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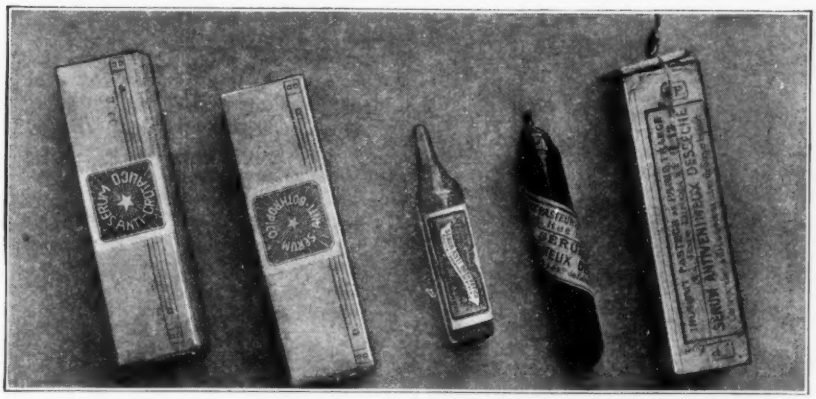
disturbed. This extraordinary story has a more extensive basis in fact than most of the popular snake myths. The fact that the joint snake is not a snake but a lizard is obscure to the ordinary observer, since it is entirely limbless and so has a snakelike form. It is, nevertheless, easily distinguished from the snakes by the presence of eyelids and ear-openings as well as by its small belly-scales and long tail. It is the length of the tail that is important to the story. Most lizards are able to lose their tails without serious injury and in many lizards—among them the joint "snake"—this tail-losing ability is very highly developed. The tail breaks at a special breakage plane and the muscle bundles are so arranged that they expand and close the arteries, preventing the loss of blood. The tail, or the pieces of the tail, are furthermore endowed with a very active reflex motion which causes them to snap and squirm and jump so that they are very much more conspicuous than the lizard's body, which is engaged in making a quiet get-away. It is not true that the pieces will join together again but it is some compensation for the lizard that it is able to grow a perfectly satisfactory new tail.



ANTI-SNAKE-BITE SERUMS

The best treatment for snake bites is serum, not whisky. Specific anti-venins are prepared for each species or group of related species. This increases the difficulty of treatment

IN a fanciful American Indian fable the toad saves himself from his enemy, the snake, by the clever expedient of taking a stick in his mouth and facing his pursuer. The Indians, apparently, did not have the widespread belief in the ability of snakes to "charm" their prey. According to this belief, the snake's eyes so fascinate its victim that the unfortunate animal is made to advance toward the snake until it is drawn into the waiting jaws. It is possible that a small bird or mouse attacked by a snake might occasionally be unable to move from fright, but the behavior of mice when fed to caged snakes does not support even this hypothesis. Mice and rats invariably display the most complete indifference to the presence of a snake.

Snakes themselves, however, may be charmed in a somewhat different sense. The professional snake charmer, with his assistants and a stock of snakes, is a familiar figure throughout the Orient. Quite the most mysterious element in this so-called snake-charming lies in the apparent response of the snakes to music. "Deaf as an adder" is an old English adage, and the deafness of snakes in general seems to be supported by the most careful scientific experiment. In most cases, the swaying of the snakes in time to the music is due to the swaying of the body of the performer, and stops when he comes to rest. The snakes used in this practice are usually poisonous species, and the favorites are the cobras, which are preferred for their spectacular hood, their habit of raising the head and body, and their connection with Hindu mythology. Sometimes these poisonous snakes are defanged, sometimes their lips are sewed shut, and sometimes they are certainly *not* so treated, but remain in full possession of their poison-apparatus. It is likely that some of the professional snake-charmers are immune to the poison because of repeated small inoculations. An adequate study of oriental snake-charming from the scientist's standpoint remains to be made.

It is interesting that the removal of the poison fangs does not make a poisonous snake permanently harmless. The teeth of snakes are shed and replaced throughout life, and the poison fangs are simply teeth modified into hypodermic needles for the injection of poison.

Most reptiles lay eggs, but it is a curious and popularly much misunderstood fact that many snakes give birth to living young. In the reptile egg the growing embryo is nourished by a large food yolk. When the eggs are retained in the mother-snake's body, development takes place and eggs may be laid with embryos at various stages of advancement. In many snakes the development of the eggs in the body until the young snakes are fully formed has become the rule, and the young are then born alive. Since the young are nourished from an egg-yolk and not from the blood of the mother, this form of development is distinguished as ovo-viviparity.

THE GLASS OR "JOINT SNAKE"

This so-called snake does not fly into pieces when struck; it loses its tail, but simply grows a new one

It is a widely held belief that the common aversion to snakes which amounts to violent fear in many persons, is instinctive in the human race. The evidence at my disposal leads me to the conclusion that this aversion and fear, when they exist, are wholly due to the example of an older person. I have never found any child who exhibited the slightest fear of snakes if he had not previously been frightened about them. On the average, in support of this observation, I find the fear of snakes much more frequent in older than in younger children. Anthropoid apes and, indeed, most monkeys, exhibit the same fear of snakes as is shown by man, but evidence exists to indicate that their fear is no more instinctive than the human.

THROUGHOUT eastern North America a snake is found which usually bears a most evil reputation. The number of popular names applied to it attest its abundance and many of them indicate its bad character. It is known variously as "hog nosed snake," "spreading adder," "blow snake," "blowing viper," and "puff adder." Terrifying tales are told of the way in which this snake actually blows its venom from a considerable distance into its victim's face, sometimes causing temporary blindness, sometimes convulsions. Although most of these stories are told at second hand, there is no dearth of actual eye-witness evidence of such poisonings.

As this snake is a common one in all sandy localities, there is no difficulty in checking up this reputation with actual observation of its behavior. In this case the facts turn out to be far more remarkable than the beliefs. As "Hog Nosed Snake" suggests, this species has a triangular flattened head, with a sharp-pointed and slightly upturned snout. The shape of its head corresponds well with the rough diagnosis of poisonous snakes as "broad-headed." In fact, when the spreading adder spreads the bones of its jaws at the rear of the head, as it does when alarmed, the head is pro-

BLOW SNAKE

Terrifying tales are told of this snake's behavior. He is a harmless "bluffer"

portionately broader than that of any rattlesnake. In addition to flattening and widening the head, the whole anterior third of the body is strongly flattened, and raised from the ground. In this position the snake faces its enemy, a more formidable looking animal than an Indian cobra of equal size. The lungs are filled with air, the middle of the body becoming twice its normal size, and if the intruder approaches the snake, it strikes and lunges viciously at him with open mouth and with loud hissing exhalations of the breath.

If one refuses to be frightened by this performance, advances upon the threatening reptile, and holds a finger within reach of its stroke, *it does not bite*. The stories about the poisonous nature of its breath are evidently fictitious, for no effect on nose or eyes can be observed. If picked up, however, the nauseous secretion of the anal scent glands is emitted, and to an already frightened person, this odor might suggest a poisonous breath. Detailed examination of the anatomy of this snake, as well as direct observation, proves that it is entirely harmless.

ANOTHER cycle of snake myths peculiar to North America relates to the hoop snake. The best-known version of these stories tells of a large snake that progresses by taking its tail in its mouth and rolling like a hoop. The tail is said to be provided with a venomous sting, and the snake capable of launching itself like a javelin, tail foremost, at an enemy. A wound by the tail-sting is almost instantly fatal, and the poison is so virulent that trees, accidentally struck by this snake, immediately wither and die. The force of its blow is such that a snake of this species has been known to strike its tail so violently into a tree as to be unable to disengage itself.

The background for this terrifying story is found in the much more widely held belief in a snake that stings with its tail, usually referred to as the "stingin' snake" or "horn snake." This, in turn, is based on the behavior of certain snakes which, when held in the hand or even confined with a stick, make exploring or apparently pricking movements with the tip of the tail. When, in addition, the tail ends in a sharp horny spine, some excuse is afforded for the belief in a tail-sting. The truth is, however, that no matter how much the tail of a snake may appear like a sting or even act like a sting, no snake has a poisonous or dangerous weapon in its tail. The elaborations of stories of a stinging snake into accounts of a snake that rolls like a hoop are of course entirely fabulous.

Two snake myths are apparently quite universal, the one to the effect that snakes—frequently some particular species—suck milk from cows, and the even more startling belief that young snakes take refuge in their mother's throat when alarmed or in danger. The two stories represent very different types of myths, the first being physically impossible, while the second is at least not impossible. It is not difficult to establish an hypothesis for the origin of the milk snake story. Cows are liable to sudden variations in milk flow from a large number of natural causes. This variation is a subject of importance to the cow's

MILK SNAKE

Milk snakes never secured milk from a cow but they have robbed the cat's saucer

owner, and a matter of frequent observation, while the true causes of the failure of the milk to flow are often obscure and rarely observable. With this mental background, if a species of snake were found to frequent barns or pastures; and if an individual snake were to be seen to drink milk from the cat's saucer or to drink the milk leaking from a cow's distended udder, a casual connection between the presence of the snakes and the fluctuations in milk flow might be suspected. The snake most often credited with this performance, and known, in fact, as the milk snake (*lampropeltis triangulum*, in eastern North America), fulfills the requirement of frequenting barns; and as snakes all drink water, it is not at all unlikely that they would drink milk on occasion. For that matter the country people in India are said to set out a saucer of milk for the cobra which frequents their premises.

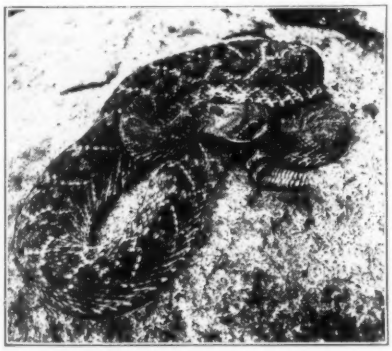
It has been suggested that some of the egg-laying snakes frequent manure piles and compost-heaps about barns for the purpose of laying their eggs. Most farmers, when they kill a snake, do so with such blind zeal and fury that little of the victim is left. The crushed eggs of a gravid snake would give forth a milk-like fluid, and this might be observed as confirmatory evidence for the belief in their ability to suck cows.

The ability of any snake to fasten itself to a cow's udder and suck milk must be considered a plain impossibility. If the six rows of needle-like recurved teeth in a snake's mouth were applied to a cow's sensitive teat, the animal would be driven into a frenzy, and the snake would be promptly dislodged by being kicked or stepped upon.

The attractive story that the mother snake receives her young into her throat to protect them from danger is apparently not physically impossible. The "snake-swallowing-young" story is supported by such plausible published accounts that even reputable herpetologists maintain, or endeavor to maintain, an open mind on this particular question.

IT has been objected that the young would immediately suffocate, or that they would be attacked by the gastric juices; but snakes do not suffocate very promptly, and there is a goodly stretch of gullet before the snake's stomach begins.

A second line of attack on the validity of this story rests on the possibility of a misinterpretation of perfectly correct, though hurried, observation. Many species of snakes, and among them the very ones to which the story is most frequently attached, give birth to living young. For several days before their actual birth these snakes are fully formed and capable of motion. As I have indicated above, snakes are commonly killed with brutal violence, and a gravid viper or garter snake or rattlesnake might then be seen to contain actual living young. An observer of the facts outlined above, especially if already familiar with the "snake-swallowing-young" story, would doubtless become an active witness for the truth of the belief.



A FINE RATTLESNAKE

Perhaps this rattlesnake can live with prairie dogs but the chances are not favorable for he is fond of small mammals

The Camel's Hump*

In It He Carries An Auxiliary Food Supply

By W. P. PYCRAFT, F.Z.S.

ONE of my correspondents wrote the other day to ask me whether the camel really does store water for his long desert journeys in his hump, or humps. There is a widespread belief that this is indeed the case. But it must share the fate of many other popular beliefs whose origins are untraceable.

The hump is really a reserve store of food, which takes the form of liquid fat, filling out a meshwork of tendinous, elastic tissue, comparable to the fat cushion on the head of the bottle-nosed whale. As the animals march, under the blazing sun, for days on end, this store is drawn upon until at last the hump assumes a flabby condition, a mere bag of skin and fibers.

And what is true of the Arabian, or one-hump camel is true also of the Bactrian, or two-humped camel in Asia. In the newly born calf, as is shown in the accompanying photograph of a young Bactrian camel, the humps are in the deflated condition, mere empty bags which will not fill out until the youngster can take solid food, and plenty of it, although I can find no record of the time taken to fill them.

What was the predisposing cause which brought about the storage of oil on the back, in humps, instead of the more usual form of fat on some other part of the body, as in other animals, is at present beyond us.

As touching the ability to store water attributed to the camels—they can indeed do this for times of stress; but it is carried, not in the hump, but in special cells or cavities of the stomach. These take the form of numerous chambers opening into the stomach, and attached to its under-surface in the form of a semi-circular belt. Most of these chambers open into the "rumen" or "paunch," but some into the "recticulum," or "honeycomb." For the stomach of the camels—which are ruminants—is composed of several inter-communicating chambers. In these animals, however, the compartment of the stomach known as the "psalterium" or "many plies," is reduced to a mere vestige.

EMERGENCY RATIONS

Adult, two-humped, Bactrian camel. Arabian camels have but a single hump

In the course of rumination, in the camels, the water swallowed is strained off from the solid food, and stored up for future use in these water-cells, which, when filled, can be closed by the contraction of muscles surrounding the aperture of each. As the march proceeds, the store, which amounts to nearly two gallons, is slowly drawn upon; but until these and the "emergency rations" of the hump are consumed, the animal can rub along without undue discomfort, although fasting, or with very little food. It does not seem to be generally realized that the stomach of the elephant is capable of storing a considerable quantity of water, although the elephant itself is not only well aware of the fact, but makes good use of it.

MY old friend, the late Captain F. C. Selous, in describing the chase of a wounded elephant, tells us that it would place its trunk in its mouth, suck up water from its stomach, and squirt it in refreshing showers over its shoulders and between its legs.

The Bactrian camel, it is to be noted, is one of the few animals which can, and will, freely drink salt water. On the Mongolian and Kirghiz steppes, indeed, it can get little else; and for its food it must contrive to subsist on the saline and bitter plants rejected by almost all other animals. Both this species and the Arabian camel contrive in some mysterious way to munch, without the slightest discomfort or injury to their mouths, the thorniest of branches, for the sake of such nourishment as they will yield. Desert plants, indeed, of whatever kind, are invariably more or less thorny. But the Bactrian camel is not necessarily a vegetarian. At need he will eat anything he may come across, including felt blankets, bones and skins of animals, and fish!

By some strange perversity the Bactrian camel is nearly always called the "dromedary." But this term should rightly be restricted to the lighter, and swifter, breeds of the one-humped or Arabian camel. But this by the way. By whatever name we call them, it must be admitted that they are ungainly-looking animals. This is partly due to the "tucked-up" condition of the abdomen, which exposes the whole length of the thigh-bone, a feature seen in no other quadrupedal mammals. But when we come to examine the legs of these animals a little closely, we find some extremely interesting relationships between structure and habit. On the true knee-joint, answering to the "stifle-joint" of the horse, there is a thick, horny pad; another is found on the wrist-joint—usually called the "knee;" and yet a third is found on the breast. These are all points of contact with the ground while the animal is at rest, and they have been developed in response to the hardening of the skin by the weight imposed. The fact that these pads are present in the newly-born camel, before ever it has rested after the manner of the adults, has been used as an argument in support of the theory of the "transmission of acquired characters," and that interpretation is surely justified, although it has probably required an immense number of generations for this transmission to be effected. Finally, the country of origin of the camels, whether of the Bactrian or the Arabian type, is unknown, for there are no really wild camels anywhere in the world; the "wild camels" living in remote parts of Turkestan are probably "feral"—that is to say, they are the descendants of animals which had escaped from captivity. Since the more primitive camelidae are all found in the New World, it is probable that camels, as we know them, came into being there and, migrating to the Old World at some remote period, became subjugated by man.

A BABY CAMEL

Its incipient humps at A are mere empty bags which hang over one side of the back

*Text and photographs courtesy of *The Illustrated London News*

The Puzzle of the Major Planets

Jupiter, Saturn, Uranus, and Neptune, Formerly Thought to be Hot, Are Now Suspected of Being Extremely Frigid, With Oceans Frozen Solid Thousands of Miles in Depth

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THE heavens are still full of puzzles, and some of them cease to bother us only because we have long been almost ready to give them up. One of these old riddles has to do with the major planets—Jupiter, Saturn, Uranus, and Neptune. What are they made of? Can we answer this question at all, and what reasons can we give for our reply?

No direct answer is possible. We must proceed by collecting all the information that we can, and then see what sense we can make of it. There is a good deal of information to be had, but some of it is perplexing. At the very start, for example, we know the masses of the planets, which can be found with great accuracy by means of their attraction on their satellites; also their diameters, which can be directly measured with the micrometer. Combining the two we can determine the mean density of the planets' material. For the inner planets this comes out from 3 to 5½ times that of water, convincing us that they are of solid masses of rock mingled, perhaps, with metal.

BUT the densities of the outer planets are surprisingly low. For Jupiter we find 1.34 times the density of water; for Uranus about the same; for Neptune a slightly greater value; and finally for Saturn a density less than that of water—only 0.71 times as great.

These values are comparable with the densities of stars, not of solid bodies. Jupiter, Uranus, and Neptune are all about as dense as the sun, and Saturn only half as dense. Now there is no difficulty in explaining the sun's low density. It is intensely hot, even on the surface, and terrifically hot inside; the expansive force of the heated gas in the interior keeps it from collapsing under the enormous weight of the overlying layers. But can we apply this reasoning to the planets?

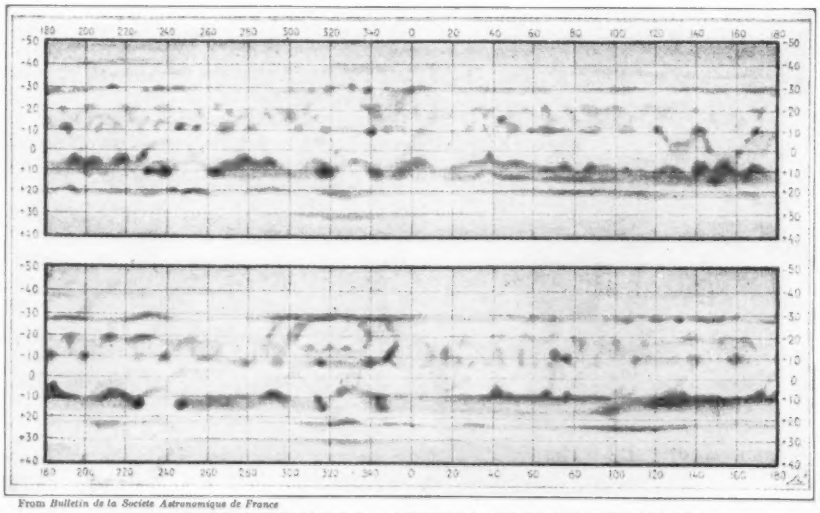
Until a decade or two ago this was supposed to be legitimate, and the older textbooks suggest that Jupiter may be hot inside, and even hot at the surface—although not quite red hot. The rapid changes of the cloud forms on its surface were attributed to boiling up of the heated material from below. But this theory died a sudden death when the radiometric measures at Flagstaff and Mount Wilson showed that Jupiter and Saturn gave out practically no measurable heat on their own account. A surface at the temperature of boiling water or even of freezing ice would send out enough heat to be easily observed, and it is generally agreed that the temperature of the visible faces of these planets must be more than 100 degrees below zero—the measures point to about 150 degrees below the centigrade, or 240 degrees below the Fahrenheit, zero.

This is not inconsistent with the rapid changes of the cloud-like markings on Jupiter's surface, for there are substances which boil at a very low temperature. Oxygen and nitrogen, for example, would condense into clouds as white as our familiar clouds of fine water drops at temperatures of minus 183 and minus 196 degrees, centigrade, at standard pressure. It is doubtful whether the atmospheres of Jupiter and Saturn are cold enough to allow this, but it is likely to happen on Uranus and Neptune unless the internal heat keeps their surfaces a good deal warmer than the sun's radiation can do.

But there are plenty of other substances, such as carbon dioxide, for example, which would form clouds at the probable temperature of Jupiter. If these substances were present in but small proportion in the atmosphere the clouds might evaporate and form again at temperatures far below the normal boiling points, as happens with clouds of water drops or ice crystals in our own air. Most substances of low boiling point are, however, colorless even in bulk, and would form white clouds. The pronounced and varied colors which appear on the surface of Jupiter, and to a less degree on Saturn, are therefore still unexplained.

It is tempting to think that the colors may not belong to the clouds themselves, but only to the many miles of overlying atmosphere through which the clouds are seen. But this as yet helps us not at all in identifying them. It should be remembered that our observations of the familiar gases at very low temperatures or in the liquid state have dealt only with thicknesses of a few inches.

WHAT would happen if we could cool a tube half a mile long with liquid air, fill it with various gases and pass light through it, is still unknown, and it may be that until someone meets the heavy expense of such an experiment we will not find out what the atmosphere of Jupiter is made of.



From *Bulletin de la Societe Astronomique de France*

TWO MAP DRAWINGS OF JUPITER, SHOWING CHANGES

Upper drawing shows appearance of planet early last November; lower one at end of same month. Made by Jacques Camus, with a 6½ inch telescope magnifying 250 diameters

One would naturally turn to the spectroscope for aid, but it only adds to our puzzlement by revealing a series of bands in the yellow and red which are increasingly prominent as we pass from Jupiter to Saturn, Uranus, and Neptune. In the last-named planet they are remarkably strong and probably account for the conspicuous green color which shows when observed visually. But no one has yet been able to match these bands in the laboratory, and we are in utter ignorance of what produces them. They are hazy and profuse in character, which suggests that they are produced in a gas of considerable density. Their steady increase of strength in the outermost planets, which are doubtless the coldest on the surface, has led Menzel to suggest that they are due to some compound or allotropic form of an element which is stable only at very low temperatures. For an atmosphere no colder than Jupiter's this compound would be almost completely decomposed by the heat (at 150 degrees below zero!), and only in the very cold atmosphere of Neptune would it be present in quantity. Here again we have to wait experiments at very low temperatures and on a huge scale.

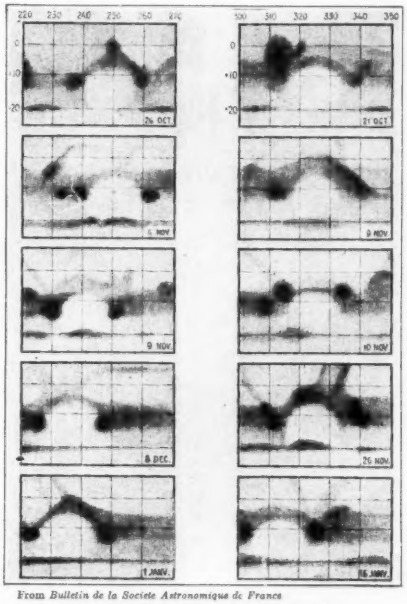
ANOTHER explanation has been given by Professor McLennan, who attributes these bands to the presence of ice on the planets' surfaces. But there are difficulties about this view and it is not generally accepted.

With so much uncertainty about the surfaces of the major planets, how can we hope to draw any conclusions regarding their interiors which we cannot even see? If we knew nothing more than the mean density of the whole mass we should be in difficulties, but we have another string to our bow.

All these large planets are in rapid rotation, and the rotation makes them oblate or flattened at the poles. Now the attraction of an oblate planet is not quite the same as if the mass were spherical, and this has effects upon the orbits of its satellites. These are always slightly elliptical in form. For a spherical planet the nearest and farthest points of the orbit, and the line of apsides which joins them, remain fixed in position. But in the case of an oblate planet this line rotates slowly forward in the direction of the satellite's motion. The greater the oblateness of the planet the faster is this motion. However, it is not the shape of the planet's *surface* alone which settles this but a sort of average of the oblateness of all the inner layers of the planet, even down to the center. For a nearly homogeneous planet the inner layers are about as much flattened as the outer, and the effect is relatively large. But if the density is much greater at the center than at the surface, the inner layers are less flattened than the outer and the average effect is diminished.

In this way it has been found from a study of the satellite orbits that all of the major planets are much denser at the center than near the surface. An effect of the same kind, but smaller, is found upon the earth where we know that the central density is four times that of the surface rocks. For Jupiter the disparity must be much more marked, and for Saturn greater still.

Now the planets were probably all produced by ejection from the sun, in the same great catastrophe, and should have been initially of similar composition. But this need not have remained the case after they solidified, for the smaller masses, like the moon, have not gravitation power enough to keep the lighter materials, like two permanent gases and water vapor, from diffusing away into space; while the larger planets can hold them all. It is natural, then, to suppose as Moulton suggested many years ago, that the major planets have retained great quantities of lighter materials which the earth and the smaller planets lost.



From *Bulletin de la Societe Astronomique de France*

TWO OBJECTS, ENLARGED

At left, a series of changes of object near 235°, in upper drawing on opposite page. At right, similar changes at 325°

What these substances were is indicated by recent studies of the solar spectrum, which show that the sun's atmosphere contains a large amount of oxygen, a good deal of helium and above all a very large proportion of hydrogen. This suggests that a planet like Jupiter, when it is cool, may be composed of a rocky core similar to the mass of the earth, covered with a vast mass of water—enough perhaps to form an ocean thousands of miles deep and veiled with an atmosphere of great extent, composed largely of hydrogen.

To what extent such a huge mass as Jupiter has actually cooled down is problematical. Jeffreys has shown that so long as a free circulation of liquid or gaseous material carried heat from the depths to the surface, cooling would be rapid. If once, however, a solid crust formed upon the core, or a mantle of ice upon the ocean, heat would be lost by the much slower process of conduction and the surface might cool to a very low temperature without any change in the deep interior.

Working on such assumptions he has shown that the known facts can be accounted for by assuming that Jupiter has a rocky core (of density three times that of water) 57,000 miles in diameter, covered by a layer of water—or perhaps ice—11,000 miles deep, with an atmosphere of small density 3500 miles thick, extending out to the visible surface. For Saturn the diameter of the core comes out 32,000 miles, the depth of the ocean 11,500 and the thickness of the atmosphere 8000 miles.

THESE figures are very rough, for no allowance has been made for the increase of density of both the core and the ocean, due to the enormous pressure to which they are subjected.

In the earth's atmosphere the density doubles for a descent of about four miles. With an atmosphere of similar composition, but with the lower temperature and greater surface gravity of the major planets, the increase would be much more rapid and unless the temperature increased rapidly at greater depths the gas at a depth of a hundred miles or so would be compressed to a density almost as great as that of the liquid into which it would condense at low temperature.

A thick atmosphere composed mainly of oxygen or nitrogen on a thoroughly cooled planet would therefore throughout its lower part be about as dense as liquid air or as water, and Jeffreys' calculations would automatically add the thickness of this part of it to that of the ocean. Since his figures show that the upper part of the atmosphere for a depth of thousands of miles must be of much lower density, there seems no escape from the conclusion that it is composed mainly of hydrogen or helium. Liquid hydrogen has a density of one fourteenth, and liquid helium one eighth, that of water and these gases even under enormous pressure would become no denser than this.

It is reasonable to suppose, therefore, that a huge, cold atmosphere of hydrogen, and perhaps helium too, overlies the surfaces of these planets.

Shooting Wild Life With a 'Movie' Camera

Goat Costumes and Improvised "Blinds" Enable Scientists to Obtain Interesting Records of Animals in Their Native Haunts

By ARTHUR NEWTON PACK
President, American Nature Association

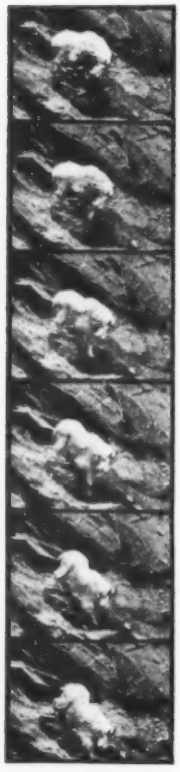
All photographs by William L. Finley and the author

"THERE HE IS"

Off on the opposite side of the ravine is a wary mountain goat, scrutinizing the vaguely goat-like figure crouched on the hilltop

"WHAT'S THAT THING?"

William Goat can hardly believe his eyes when he sees William Finley, garbed as a goat, operate a camera with his "front feet"



ON a rocky pinnacle far above the glacier is a white figure. From its head stick two black horns. Its white whiskers toss in the breeze. What seems to be a shaggy coat is ruffled by the wind. In this, a mountain goat country, it must be none other than a mountain goat. But something is wrong. Sure of foot as are these white inhabitants of the crags, none has yet been seen to stand poised on its hind feet and gaze intently about it. And when this odd animal reaches one foreleg into its ample bosom and draws forth an irregular black thing with a longish snout, any watching and wondering mountain goat—or uninitiated human, for that matter—might be expected to flee or investigate.

This was no strange goat hitherto unknown to science. It was merely Bill Finley trying to act like a mountain billy for the benefit of the bona fide billy goats of the upper reaches of Glacier National Park. The year before, our expedition had successfully filmed mountain sheep, elk, beaver, many small mammals, and mountain goats. Bill Finley, however, has devoted the last 30 years of his life to taking pictures of the wild world where it is wildest and knows what he wants to get. We had not been satisfied with our first year's films of mountain goats, so when Bill turned up for the second expedition he had with him something new in goat-getting equipment.

IT was like a glorified white flannel nightie, this grotesque affair, gathered in at the legs, adorned with a pair of flapping ears, quite presentable horns, flowing beard, and with a face-opening like an ancient suit of armor. He had kept the device a secret from the rest of us until we had worked our way into the goat country. Then he clambered into it while the rest of us suffered from pangs of laughter necessarily smothered because we had spotted some goats. Sticking the camera into the loose bosom of his circus suit, Bill declared, "I'm going to be as goaty as the goatiest goat. I'm all set but the smell and thank heaven for a head wind. Here goes."

Down the mountainside the bogus

◄ **GOING DOWN**

A telephoto lens caught the movements of this old billy as he sprang down

ON THE JUMP ►

Bounding across the camera's field, this deer served as a graceful artist's model

goat dropped, clambering in the direction of the real billy we had located on a crag a perilous but not considerable distance away. It was not long before the real billy spotted this apparition and paused to sniff the air. It revealed no taint of man smell so he continued grazing on a sparse outcropping of green. Bill, also, stopped to "graze," then moved on. Billy looked again, somewhat more puzzled but still not greatly disturbed. He kicked away a few small rocks and lay down on his craggy niche. Bill tried the same thing, not quite as nonchalantly, perhaps, since this cliff-dwelling business is more in the line of the rightful inhabitants, but the act went over.

THE short calm brought reassurance and Bill tried some more nearby grass. Billy got up, waggled his ears, and actually looked worried. Still Bill got nearer. Billy, puzzled, lay down again. On ambled the bogus goat. One hundred feet now! Suddenly the fore-hoof of this weird goat disappeared into its stomach, and from the black box and tube that it brought forth came a terrible buzz. No friendly goat had ever buzzed at Billy like that, and his knowledge of "movie" cameras and their whirring sprockets was exactly nil. For a moment he paused, a look of supreme wonderment on his face, like a child who has seen its first choo-choo train go thundering past. Then away, fleeing from precarious crag to dizzy cliff-edge, down what seemed like the sheer side of the precipitous mountain, away toward the Arctic Circle.

Upright now, camera under one arm, the bogus billy picked his way back. Planting one hoof on his voluminous whiskers and the other behind an ear, he opened wide his face.

"Well, that's one goat that's got," said Bill, as he stuffed a most ungoat-like bacon sandwich into his mouth.

We continued to work in this vicinity and the goat costume served well. We all tried it with varied and amusing results. Apparently the news of this strange intruder—this weird creation of the god of goats—had not spread. We stalked nannies and played hide and seek with them behind great rocks and around ledges. We filmed mountain goats in groups and singly. We played upon a natural curiosity they seem to possess, a trait that often stills fear to a degree delightful for the wild life photographer. And later, when the films emerged from the developing bath and the prints were made and run through the projection machine, they were, indeed, high tribute to Bill's glorified nightie.

THE GOAT-PHOTOGRAPHER

Above: Mr. Finley as the strange goat with a camera; and *left,* Mr. Finley when an ordinary human being

Goats, however, were not our only goal. On "movie" hunting expeditions of this sort into difficulty country, where wild life is really wild, one must learn the places where what one seeks may best be found. Often the first visit serves only to chart the way, to yield enough good "shots" to whet the appetite for more and to make the second visit more richly productive. This was true of our Glacier Park expeditions.

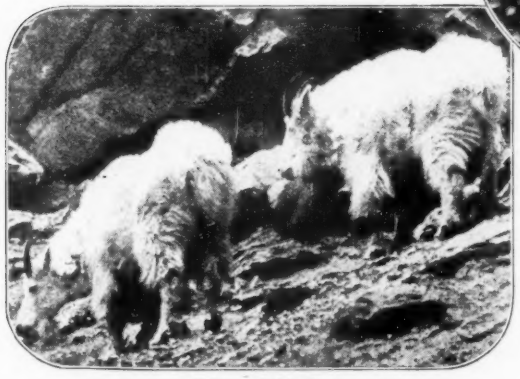
CURIOSITY

On our first trip we had found a favorite lake for beaver, where these busy fellows build dams much to the annoyance of the rangers. A dynamited dam only temporarily released the water because a few days found the barrier as strong as ever. In the fading light of the long mountain day we had gotten some rare shots of Pa Beaver dragging saplings back to rebuild his shattered dam. So back we went this time and met Pa and Ma and most of their relatives. We photographed them at their work. We took them to camp with us as overnight guests and filmed them fore and aft, paddle-like tail to efficient claw, and sent them back to their families with a thrilling tale that must have enlivened many a quiet winter evening in local beaver circles.

MANY birds and small mammals posed for our whirring cameras. Deer and bear, protected in a National Park, proved friendly and investigated our camp. In fact one bruin proved entirely too friendly, and while some excellent films were made, our larder was depleted by a destructive and undiscriminating bear appetite.

Then we found a mineral lick and there got our pictures of that most beautiful and stately member of the deer tribe, the American elk, or wapiti. Patience and planning, the two essential ingredients for the wild life "movie" pudding, brought results. After a couple of days of stalking and studying, our party of four divided. Two of us worked down the creek below the lick where tracks showed where the wapiti crossed the stream on their way to the lick. Each took a side of the creek to be sure that one or the other got results and waited for the others to inspire the deer to leave the lick and go back along the trail.

Almost before we were set we heard



SURE-FOOTED

Venerable patriarchs of the mountains, these billies display much interest in the photographer's costume

the pounding of hoofs and the crash of running elk on the hillside. Hardly had we gotten out of the trail and our ready cameras up than three cow elk came down the slope leaping logs and underbrush with glorious lack of effort. Past they went, dashing the creek into showers of glistening spray. A calf clung close to its mother's flank and all paused in mid-stream as the woods sounded with another crash. Past us went a great, antlered bull. Leaping lightly over a fallen log, he landed in the stream and they were all soon lost in the dark of the trees. With us, however, they had left the story of their passing in all its graceful detail.

Both Bill and I had gotten them and were shouting to compare notes when another band of wapiti came tearing by. Some

EARS, HORNS, AND ALL

A close-up of the photographer in his successful disguise, showing the opening for vision

FOUR LEGGED?

Poised on a rock, beard waving in the breeze—a strange sight for the billies

find a thrill in placing a bullet so that it will bring such glorious animals down that their antlered heads may be mounted in some hunter's den. For us there is a far greater thrill in the more difficult sport of carrying home on the film the true story of such an animal in all its free, wild beauty. It is far more soul-satisfying to us to live over the thrill of the moment as it is revealed on the screen than to gaze at the glassy-eyed stare of a mounted head.

It was not the stirring experience of "shooting" our wapiti or the amusing subterfuge with our mountain billies, however, which supplied the biggest event and the greatest pictures on our last trip. We were out to get moose on this camera hunt and get them we would if we could find them and lived. Moose there were, but there were moments when our continued existence was a matter of doubt—to us, at least.

"Moose? Sure," declared Scotty, the fire ranger at the lookout station above Bowman Lake. So we camped there and waited for Scotty to produce and to report sight or trace of these big-antlered fellows.

While waiting we started campaigning ourselves. Not far back from the river channel we found a stagnant pool of foul water. It was ringed with tracks of moose. Enough for us, so on the little spit of land we built a blind among several small trees, laying boughs against these slender saplings. We settled down here but four mooseless days passed with only a few shots of mergansers, some ground squirrels, and a white-tailed buck deer or two. Scotty was fast losing our confidence when word came that moose were in the vicinity. Off we hurried, crept up to our blind and cautiously into it.

Sure enough, across the river on the edge of the woods was a moose cow and her calf. The wind was toward us and she scented no danger, nor could the little clump of trees have looked much different to her. With her youngster she trotted down the opposite bank and into the river, straight toward us. Our cameras buzzed but their noise must have been drowned by the splashing water. Out on the near bank she came and toward the pool of muddy water. Some scent of danger must have reached here when she was less than 150 feet away because she veered off from the range of my camera but directly into Bill's. She performed beautifully for us, not 75 feet from Bill's buzzing film box, had a drink of muddy water and then trotted down stream, swam into deep water and disappeared on the other shore.

Jubilantly we lighted our pipes and told each other how blooming big the old cow had looked in our finders. In hopes we stayed on, but by five-thirty we were cold and about ready to call it a day. Some sandwiches and oranges decided us to try another half hour and hardly had we settled back to watch when the cow appeared again at the edge of the woods, looking straight at our blind. For some moments she stood like a statue except for a flick of her ear, then she turned into the forest again.

CRAWLING ALONG

Mr. Finley stopped at times apparently to graze, to allay the goats' suspicions

TRANSPORTATION FACILITIES

The cameras and equipment for the photographic expedition into the mountains were carried on pack horses

Hardly had the cow gone than there appeared on the opposite bank a grand old bull moose. The missus had made a report. He paused a moment and then plunged into the stream. The cow and calf followed in his wake. Then the fun started. While the old man came on directly toward the front of the blind, mother and child worked around behind us. I looked over my shoulder.

"Great Scott, Bill," I whispered, "the old lady's coming in the back way. She'll step on us and drive us out of here. We're surrounded by moose."

"Yep," said Bill, "Too much moose."

The old bull came on, straight at the blind. Twenty-five feet! Fifteen feet! What was in those trees, he didn't know. Should he find out? Should he charge with those great, powerful, murderous antlers and put a stop to that buzz? He must have been pondering something like this; and how we

wished those slender saplings were foot-thick trees! Four cameras we had and through the sprockets of each the film sped until we must reload. It is a trick to stick your head into a loading bag and load a camera with a bull moose outside trying to decide on a charge and you with a fine case of buck fever complicated with fright. If you don't believe me, try it.

By some kind fortune the sprockets caught and I handed Bill the camera just as the big fellow decided to move a few feet to the pool edge to have a drink and think it over. He went down on his knees and drank fully. Then he rose and came back. Facing us so close that his broad antlers filled the finder to overflowing, he swayed his head back and forth. He grunted; and the next time I hear such a grunt I hope it's from behind zoo bars. He would go back to the pool and watch us, then come closer again. Once he raised his hind foot and scratched his ear. Comic relief!

MOOSE

Many feet of interesting film were obtained from the shelter of a "blind." We reproduce here two frames of the thousands exposed

The old bull went quickly back to character, however, and gave his antlered head another toss of truculent warning. He was now directly behind the blind and completely between us and the nearest shelter. How good those huskier trees looked as we peeped through our own slender saplings at that well-equipped head! In what spare moments I had between getting shots of my own and keeping a weather eye on the old fellow all of the time, I pondered on why he had not lowered his head and made a dive for the blind. There was, of course, the probability that he was loath to take any chances by barging in to destroy something he knew nothing about and which made noises new to his experience. It seemed certain that some such thought was in his mind for he was really angry, very likely at himself, in part, because he couldn't solve the problem to his own satisfaction. There was also the possibility that his antlers were still a bit tender and although the trees which shielded us were not such serious opposition to him, he did not care to risk a charge without good and sufficient reason. But the fact remained that there he was and there we were—and what to do!

HEADED FOR THE CAMERA

The author and Mr. Finley spent many anxious moments in a flimsy blind when this huge bull moose seemed about to charge toward their frail shelter, but he changed his mind

Now Bill Finley is a brave man and wild-life wise. It struck him there was one way of saving our skins, probably at the expense of only one camera. Out of the blind he went, setting up one of the machines on a tripod. He figured the old moose would more likely charge the thing he could see and in the rush we could dive into the bushes to the right and left while the old boy kept on to the river. He glared and grunted at this new contraption.

BILL'S camera started up with a buzz. I dropped the spool and loading bag and the moose turned my way, grunted and swayed some more. Bill's hundred feet of film gave out and he reached for the loaded decoy camera. The tripod clattered down and the bull for the first time showed fear. He moved off a few feet and, Heaven save him, Bill after him, buzzing as he went. Bill had figured the moose would have charged already if he was going to and there was larger timber not far away. It was clear the old fellow was angry but he didn't understand this business and therefore was somewhat afraid of it. Once he turned as though he had made up his mind, then grunted and drew off to the big timber. He disappeared, following his family that had gone earlier.

In that puny blind the old bull moose left three people who had had a big scare and a great thrill, and who sat among a clutter of camera equipment and sighed in unison. He also left 500 feet of movie film that had only one fault—it was so good that most people would declare it had been made in a zoo. It wasn't!

BUSY AS A BEAVER

Forest rangers dynamited a beaver dam, but the little workers went right back to work and the barrier was restored to its original strength only a few days later and the pond was full

SKIRTING THE ROCKIES

An Eaglerock plane in a banked turn, flying over the level plains east of Colorado Springs. Pike's Peak, which is barely discernable in the background, is surrounded by several other snow-capped peaks of the Rampart range of the Rockies

Learning to Fly From the Ground Up

Students in Flying School Study Design and Construction in Airplane Factory

BY H. CHASE STONE
Director, Pike's Peak Flying School

"LEARN to fly in high altitude and you can fly anywhere" has long been an accepted axiom in the aviation industry. Situated at the western edge of the great plains and overshadowed by the snow-capped peaks of the Rampart range of the Rocky Mountains, Colorado Springs has long been a favored site for a flying school. Another factor that contributed to the ability of the Pike's Peak Flying School to attract aviation students from all sections of the country is the presence here of the factory of the Alexander Aircraft Company. The opportunity to study airplane designing, construction, and factory management is an important consideration, particularly to students who intend to take up aviation as a vocation.

Our first group of students consisted, for the most part, of those interested in aviation as a sport and included polo enthusiasts, golfers, tennis players, and young business men. Some few of the students were interested in aviation as a career and followed their course of instruction with the purchase of planes to be used in commercial work.

The next group of students enrolling in our school was more promising. These were young men who intended to follow flying as a career. The group included youths from farms, from factories, and from middle-class families, who preferred to invest their savings in limited commercial flying courses, rather than a college course. Some of them were able to pay for flying time enough to secure transport licenses. It was with the enrollment of such a group of students that we decided to expand our courses. For the first time, we instituted a complete ground school course.

We found that "high altitude flying" and the opportunity to study airplane construction while learning to fly provided a combination eagerly sought by embryo aviators. Through the co-operation of J. Don Alexander, president of the Alexander Aircraft Company, the students of the Pike's Peak Flying School are received into the factory for instruction. The students of our school are given every possible bit of assistance here. They are transferred from one department to another as they show progress, and by the time they have completed their flying course they have secured a working knowledge of every phase of airplane construction.

THE students are first instructed in the rigging line, where the wings of the planes are attached to the fuselage and the ships are accurately rigged prior to being test flown. They gain valuable experience in this department and are firmly impressed with the value of accuracy in the rigging of airplanes. They are also taught to conduct a complete final inspection of a ship before it is to be flown.

When a thorough knowledge of the completed airplane is gained, they are started on a prescribed route through the factory, covering a period of several weeks, each phase of the work being explained to them by competent

OFFICIALS OF THE PIKE'S PEAK FLYING SCHOOL

The writer with Don Diegel (left) who is an instructor at the Pike's Peak Flying School and also chief test pilot for the Alexander Aircraft Company, makers of Eaglerock airplanes

supervisors. Upon completion of the course, every student has a working knowledge of each phase pertaining to the manufacture and production of commercial airplanes.

This instruction in the factory supplements the course in flying, and leaves time to spend in the air. Appointments for flying time can be made during the day, and the student has only to walk about 300 feet across the highway to the 260-acre airport where the school planes are kept. As for the students who are regularly employed in the airplane factory, the flying school instructors make appointments from daylight until 7:30 in the morning when the shop opens, or after 4:30 in the afternoon when the factory closes, to enable these men to receive their flying instruction.

Students taking such a combination course have an advantage in the aviation industry of the future by reason of their dual knowledge of flying and airplane design, construction, and repair. Also, by working in the factory during their course of instruction, their day is completely taken up with constructive efforts for learning the complete science of aeronautics. We impress upon our students the value of observation, for much can be learned by watching and working beside an expert.

ONE of our instructors, Don Diegel, is chief test pilot for the Alexander company. He tests every ship coming off the factory line. The students gain much from observing this type of work.

So far I have not touched upon the advantages of altitude flying. Colorado Springs is situated on a plateau at the base of the Rampart range of the Rocky Mountains, at the foot of Pike's Peak. The altitude of Colorado Springs is 6036 feet above sea level. The difficulties of handling a plane at this altitude have long been recognized by veteran flyers. The air is more rarefied and take-offs necessitate longer runways, and landings must be made at a greater speed than at sea level. To the flying novice who learns to get off the earth from an airport at more than a mile above sea level, and who learns his landings well at this height, there can be few difficulties wherever he may fly.

AVIATION STUDENTS WORKING IN THE EAGLEROCK FACTORY

Interior view of the fully equipped factory at Colorado Springs, where aviation students of the Pike's Peak Flying School receive instruction in aircraft design, construction and assembly, while learning to fly in the rarefied atmosphere more than a mile above sea level

The rarefied air in the vicinity of Colorado Springs offered considerable difficulty the first year we were operating. At that time we were using Eaglerock planes powered with OX-5 motors. It was only early in the morning and late in the afternoon that the air was dense enough for these low-powered planes to get off the ground with sufficient safety for student instruction. During the middle of the day when the sun beat down on the airport, the air was so thin that the 90-horsepower motors could scarcely lift the planes. We decided to purchase more powerful planes and bought two Eaglerocks equipped with 150-horsepower Hispano-Suiza motors. These planes proved ideal for our purpose.

We next instituted the Rankin system of flying in order to secure a bona-fide ground school system, and we made a valuable connection with Colorado College, one of the oldest institutions of learning in the west, located in Colorado Springs. The college officials proved more than ready to co-operate, and loaned us several of their engineering staff as instructors in the various phases of ground school work.

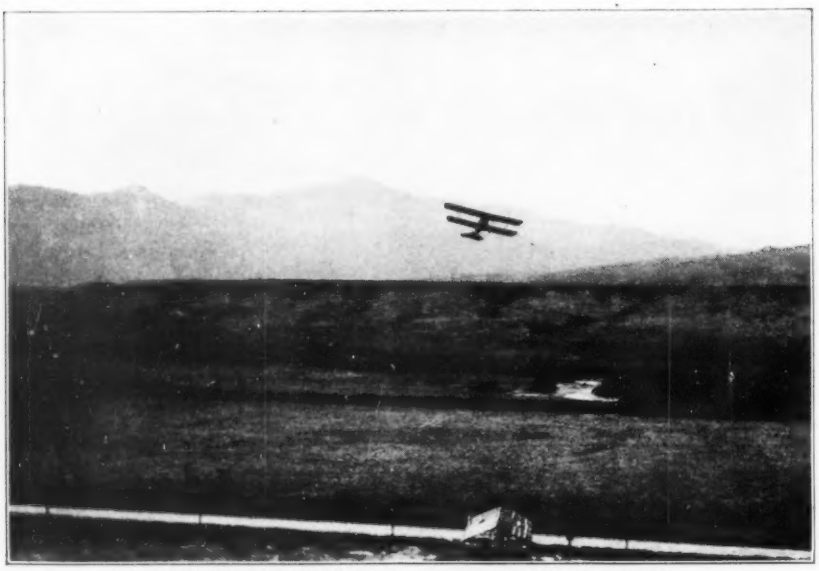
When a student arrives for enrollment in the Pike's Peak Flying School, he is first given about ten days ground school work before being permitted to take flying instruction. Following the completion of this ten-day course he is given a dual flight with Don Diegel. Immediately he is allowed to handle the controls in dual instruction. After a period of ten hours or more of dual instruction, he is permitted to take his first solo flight. Following this, he is allowed to continue to take the ship up alone but with periodic check hops by the instructor. These check hops are given to the fledgling in order that the instructor may correct in time any faults into which the student may have fallen.

FLYING ALONG THE EASTERN EDGE OF THE MOUNTAINS

Within a few miles of Pike's Peak and the Garden of the Gods, the embryo pilot has a magnificent panorama while accumulating the 50 hours in the air necessary to get a license

THE primary student instruction is carried on out over the miles and miles of level plains lying to the east of Colorado Springs. Here the students can fly and land at will without the usual mental hazards that so often accompany the average student training, due to dangerous landing conditions beneath.

In the later stages of their instruction, the students are introduced to the peculiarities of the air conditions which sometimes exist around the mountains. The secret here of mountain flying is in retaining sufficient



TEACHING BEGINNERS TO FLY IN HIGH ALTITUDES

Pilots accustomed to the atmospheric conditions encountered in high altitudes can fly almost anywhere, but those accustomed to flying at low altitudes are handicapped at higher levels

altitude at all times so that the upward and downward drafts have relatively little effect in relation to the mountains. In experiencing these sensations the students gain valuable experience in handling the equipment under difficult conditions. At all times while flying over the mountains, either on student work or passenger flights, the planes are within gliding distance of our airport. The safety of flying over Pike's Peak, which has an altitude of more than 14,000 feet, was demonstrated by us a few weeks ago. The motor of a plane was shut off while directly over the summit of the Peak, and the plane glided back to our airport with still a reserve of 4000 feet altitude.

During all this time the student is continuing his ground school course and is spending much time in the aircraft factory. When he has completed 50 hours of solo flight, a local inspector for the Department of Commerce gives the fledgling an examination. If the student passes the examination, he is issued a limited commercial license.

THE pilot then may continue his studies and obtain more flying hours, or he may procure his own plane to continue his hours in order to secure a transport license. Some of our graduates have taken up piloting of planes owned by individuals in order to secure the needed hours. Some of them, after graduation, "ferry" ships for the Alexander company; that is, deliver ships from the factory to the purchaser. In this manner they secure valuable cross-country experience as well as earn money, while flying the necessary 200 hours.

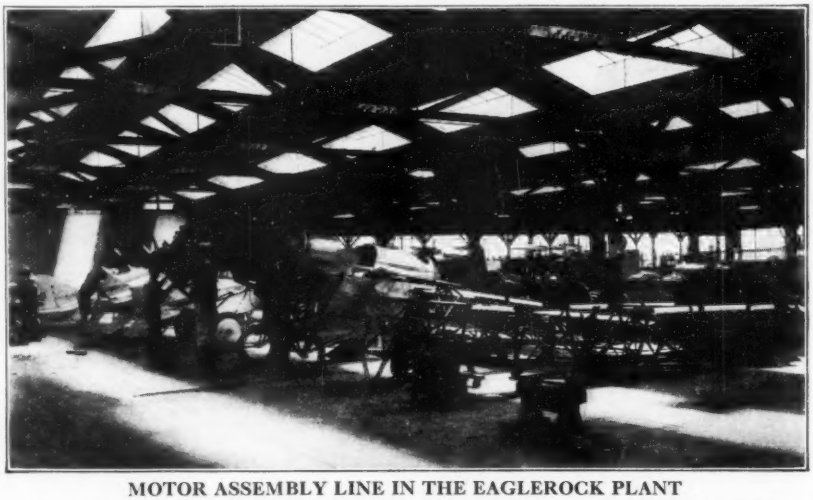
The fledging on his solo hops around Colorado Springs secures more knowledge of air currents than many veteran pilots have ever learned. During the Pike's Peak air meet, held in Colorado Springs in August, 1928, the chief attraction for the pioneer army and commercial pilots was the mountains. Virtually every pilot took his plane for short jaunts over Pike's Peak or some of the lesser mountains, just for the experience. All of them were surprised by the many things they learned concerning down currents and up drafts. They had all been taught these facts but had never learned them by personal experience.

It was also noticeable during the air meet that pilots who had never flown in high altitudes before had difficulty in taking off and in landing. Many of the army flyers who had thousands of hours to their credit would hang the plane by the propeller on taking off or stall into the airport on landing. They could not realize that high altitude necessitated a long take-off and high landing speed. The fast army pursuit planes, for example, which landed at Kelly Field, Texas, at 60 miles an hour came into the airport in Colorado Springs at nearly 90 miles an hour. For that reason larger airports have been constructed in cities situated in high altitudes.

By the time the student is eligible to take an examination for a limited commercial license, he has flown over many of the nearby peaks and is undaunted by mountain flying. He is fully qualified to take a plane across the country.

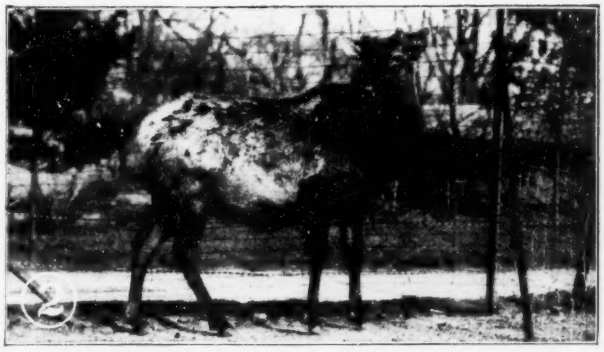
The chief spirit we have tried to inculcate in our personnel and in our students is that of "safe flying." We do not permit stunt flying by our students. Everything possible is done by the instructors and ground crew to eliminate recklessness on the part of students. Much of this spirit is due to the personnel of the school. Don Diegel is our chief pilot. The field manager is Lawrence Dettling, one of our first graduates who has remained as a pilot and chief mechanic. He will soon be promoted to chief operations officer of a scenic air tour company which we are starting. Stewart Wandell, although a competent pilot, prefers to be an expert motor mechanic and spends eight to twelve hours each day nursing the "Hisso" motors and making minor repairs on the planes.

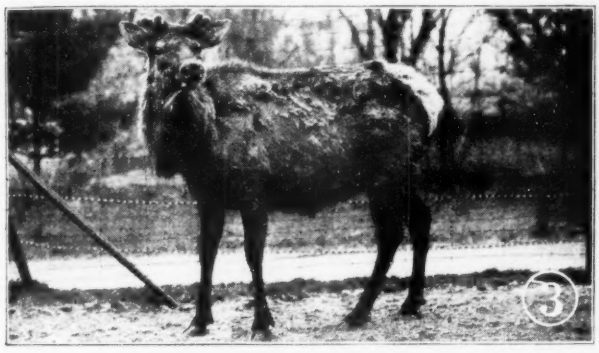
SEVERAL members of the Alexander Aircraft Company's sales staff are transport pilots and they assist whenever needed in instruction work and in passenger carrying. Two of these are O. R. (Ted) Haueter and J. A. McInaney. O. M. (Red) Mosier, a well-known cross-country pilot, will be the head of the newly formed scenic line and will give advanced instruction in aerobatics and cross-country work.

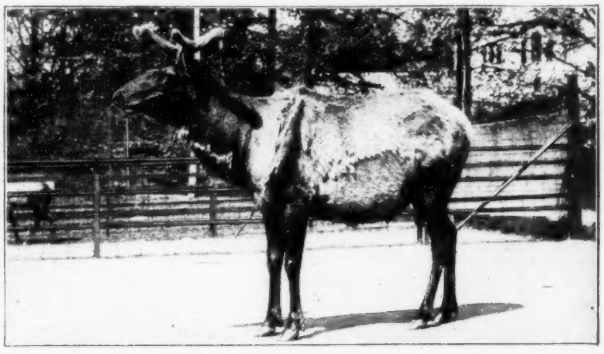


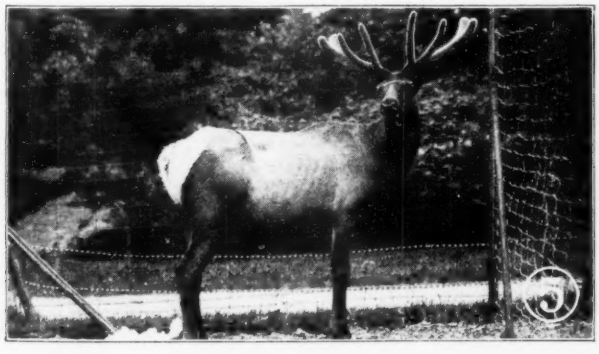
MOTOR ASSEMBLY LINE IN THE EAGLEROCK PLANT

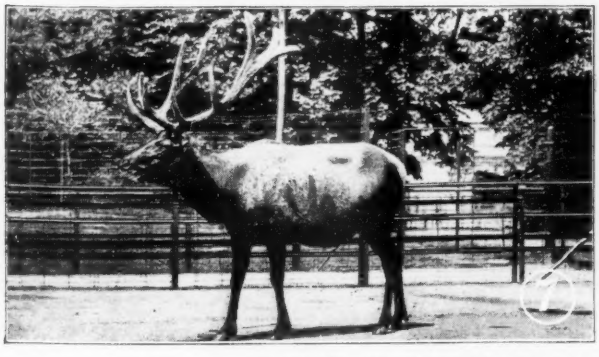
Every phase of aircraft construction is studied by those enrolled in the flying school course; upon completing their studies many pilots with limited licenses "ferry" planes for extra hours





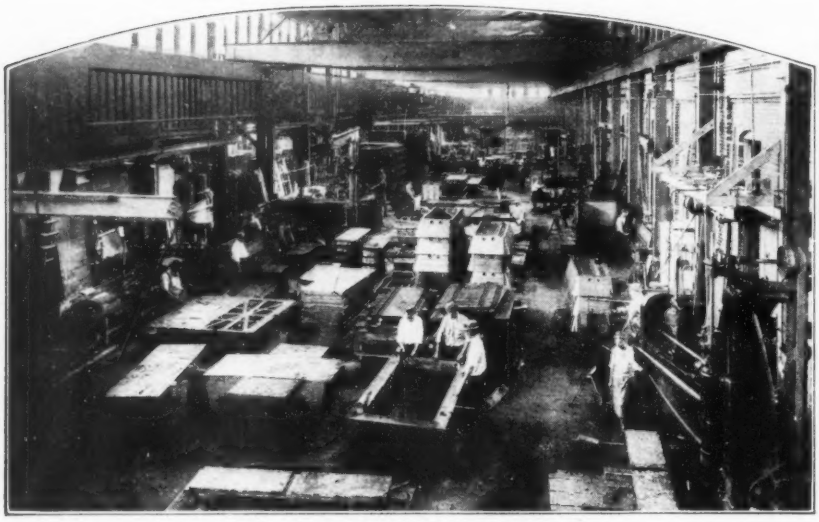






Off With the Old Antlers and On With the New

THE wapiti deer, now confined to the western part of the United States and portions of Canada, and erroneously called elk in America, sheds its antlers annually along with its winter coat and during spring and summer grows a full new spread. The interesting stages of this new growth are shown in the series of photographs on this page which were taken by Elwin R. Sanborn at the New York Zoological Park. Photograph (1) shows the wapiti just after the old antlers have been shed in March; (2) the new antler appears as a bud on the old pedicle and the winter coat begins to go, April 25; (3) the antlers grow fast and the branches appear, April 29; (4) the branching begins to foretell the pattern of final growth and the last of the hair is ready to shed, May 9; (5) the old coat is gone and antlers larger, June 1; (6) the thick covering of velvet makes the antlers look clumsy, June 25; (7) the full pattern is completed and the antlers harden in August; (8) the velvet is now dead tissue and the wapiti gets rid of it by rubbing against trees. Photographs and material courtesy the *Bulletin of the New York Zoological Society.*



VAULT FITTING FLOOR OF PLANT

The vault doors and vestibules come in at one end as rough steel castings. They pass from machine to machine until they are fitted with bolts at the other end of the room

Foiling the Burglar—II

The Time Element Versus the Burglar. A Continual Battle of Keen Minds

By A. A. HOPKINS

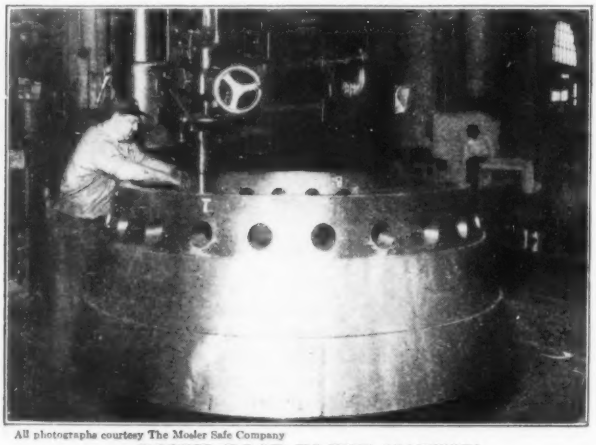
Author of "The Lure of the Lock."

IN our last issue we showed how man tried to protect his valuables, as secret hiding places had been found to be impractical. Another angle of the problem relates to the form of the container which was often an oaken chest, metal bound and locked with cumbersome bolts, and controlled in many cases by trick or secret locks. With the increase in quantity of valuables, we find the banker coming into the picture, for he, and only he, could assemble a number of chests in a strong room with thick walls, heavy doors, and cleverly designed locks which looked formidable even though their defense might be weak. This was the precursor of the modern vault which developed along two dissimilar lines.

First we have the "continental vault" and second the "American vault." The continental vault consists of a fireproof vault with little or no burglar-proof qualities, filled with a number of very strong and presumably burglar-proof safes. This is, in principle, a reversion to the plans of the Fuggers or other medieval bankers. (The continental vault designer will tell you that if an American vault is burglarized—if the lining has been penetrated or the door opened burglariously—the contents of the vault are practically at the mercy of the intruder, due to the fact that the containers inside the vault are not of extraordinary strength. He would say that this was putting all the eggs in one basket.) There are some exceptions for some governmental depositories abroad are veritable citadels, but the branch bank vault is ordinarily meant. Of course, our American theory is that, if we make the surrounding walls and the doors as strong as possible, taking into consideration the permissible outlay for any given job, we have protected the entire interior.

With the extreme thickness of doors, vault walls, et cetera, in this country, we are given so much more protection in the aggregate than would a number of safes contained within the vault, that we may consider this a better method of protection.

THE American vault differs in that the entire vault is not only fireproof but is made as burglar-proof as possible by the aid of the finest materials, impeccable workmanship, and the creative ability of the vault engineer. The masonry structure is usually of very heavily reinforced concrete. This is lined with heavy metal on all four walls, the floor, and the ceiling. The metal work is a combination of plates and angles containing open-hearth steel, drill-proof steel, and torch-resisting metal. The doors are massive structures of enormous thickness. They are commensurate in strength with the masonry work and lining so that together they make a burglar-proof room, the contents of which are amply protected. In practice, the American vault when constructed with extremely heavy doors and built with reinforced concrete walls, could withstand mob violence for a considerable period of time while the continental vault would



All photographs courtesy The Mosler Safe Company

ROUND DOOR IN THE MAKING

This enormous door will protect millions in securities. It will have 25 round radial locking bolts. The door is being drilled

STRONGER THAN BURGLAR'S TOOLS

A drill-proof and torch-proof slab is here being lowered into the shell of the vault door. It is only one of several built-in layers

not resist such a massed attack.

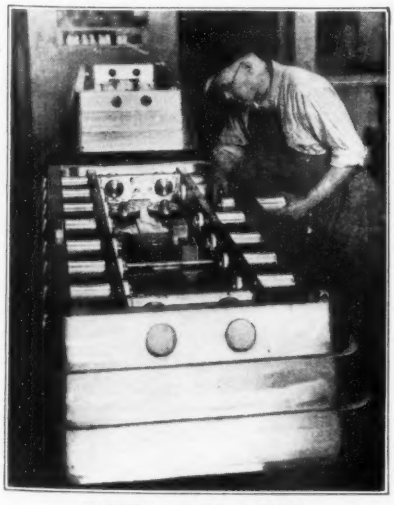
All this brings us to an important point which may be termed "time and the burglar." Given time and tools no vault is invulnerable. But power tools could hardly be used except under mob domination and a field piece to attack the walls of a vault is not usually a part of the burglar's equipment. The object of the vault engineers and the builders is to prepare a barrier which makes it impossible for a burglar to penetrate the structure in a few hours. Now let us see what is done to fend off the burglar.

If possible, vaults should be located on or near bed rock. The vault should stand away from the walls so that guards can pass entirely around it. It should be a reinforced room or chamber with walls made as thick, and reinforced as heavily as the building conditions and the available funds will permit. The lining inside should embody three types of resistance in the "layup": resistance to explosive violence, drilling, and burning.

THIS practically fixes a minimum thickness of lining as two and one-half inches made up as follows:

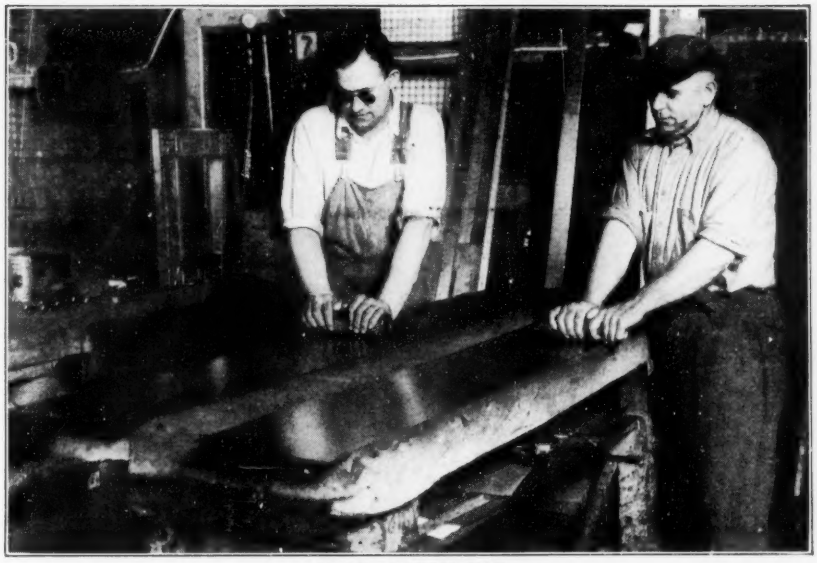
Outer layer,	½″	open hearth steel
Second layer,	1″	torch-resisting metal
Third layer,	½″	five-ply chrome steel
Fourth layer,	½″	open-hearth steel
	2½″	total

The torch-resisting metal could be increased by one inch with advantage and the outer layer might be doubled in thickness; vault engineers and underwriters are not all in agreement on this subject. One burglarious method of entering a vault with reinforced wall and steel lining is to take away a section of the concrete envelope, cut a manhole-size opening through the lining, push the released disk into the vault, and climb in. A buttressing wall is sometimes built inside so that a cut-out disk could not be pushed in or pulled out and would have to be removed in small sections thus taking up much time—and time is the burglar's Nemesis.



FITTING THE BOLTS

Each bolt must be individually adjusted and fitted to take a firm, smooth bearing



HAND POLISHING

After machining and grinding the plates, the bars and other portions are polished by hand labor with emery and oil to give the beautiful finish we usually associate with vault work

The other alternative for the cracksman is to try to enter by one of the doors, of which there are generally two. As explained above, it is necessary to cut a manhole in the lining, but with the door this is different.

THE boltwork which locks a door is operated by a handle or wheel and controlled by combination locks which are checked by time-locks. If the train of mechanism between the boltwork and the locks be broken at any point, it would then be possible to throw the bolts and open the door upon its own hinges, so that a triumphal entry might be made. To break this connection it is only necessary to put a hole through the door approximately one or one and one-quarter inches in diameter. This is sufficient to allow the burning of the connection above mentioned, or the insertion of a bar or cold chisel with which the connection can be broken. For this reason the door is the logical point for burglarious attack and it must be much thicker and stronger than the lining. Doors 36 inches in thickness are not unusual.

The door and the vestibule frame are of cast steel properly annealed. The laminations are placed within this shell, or casting. This is technically known as filling and is illustrated in this article. In addition to the various metals enumerated, a very expensive and very efficient metal, or rather alloy, is sometimes added to render the door practically invulnerable. Doors are either made rectangular or round. A rectangular door properly constructed with heavily rounded corners is just as strong as a circular door and, with modern methods of machining, fits into its joint frame quite as tightly. The real advantage of a circular door today is its advertising value and its appeal to the public. For this reason large banks frequently have two doors leading into the same vault area—a circular door for the safe deposit compartment and a rectangular door for the bank or security compartment. Needless to say, a circular door is much more expensive than a rectangular door.

Every high grade vault should have two doors: a main door and a smaller, emergency door. If for any reason the main door cannot be opened by reason of attack, failure of the mechanism to function (a remote possibility) or for any other reason, the emergency door comes into play. This door must be as strong in every way as the main door and provided with both combination and time-locks. There are, however, thousands of vaults with only one door.

ELECTRICAL protection is an excellent auxiliary but is never a substitute for the main line of defense—the vault. The electrical safeguards, if placed on the outside, will give the burglar less time to operate. Guards or watchmen who ring in regularly to the police station or some protection company are valuable if able-bodied and conscientious, but pensioners are not desirable for this position. Observation space above and below—where the vault does not rest on bed rock—is desirable, and with the use of lights and mirrors, no boring or tunneling

can proceed without being detected.

A plant for the manufacture of safes and vaults is very largely a ground floor proposition owing to the great weights involved. At a factory the doors are fabricated and much of the material for the vault walls is prepared, as are also the internal fittings of vaults. The locks themselves are made at a separate factory.

On the vault-fitting floor, the heavy vault doors and vestibules with their component parts are machined and assembled. The open-hearth steel castings pass down the length of the shop from one machine to the other until the doors are set into the vestibules, the hinges and pressure systems applied, and the bolts and boltwork mechanism attached. The work is then arranged so that the doors can be up-ended and taken to the final assembling department where the finishing touches are given. The heavy doors are transported by special cradles suspended from traveling cranes.

ONE of our illustrations shows a door, the inner surface of which is being drilled for the purpose of attaching the mechanism which actuates the bolts. The raw casting has passed through the boring mills where the exterior and interior surfaces are accurately turned and ground; and 24 radial, round locking-bolts will subsequently be applied. The interior of this door or shell is filled with successive layers of open-hearth steel, drill-proof steel, and torch-proof metal so that the three methods of attack known to modern burglars have been thwarted in this type of construction.

Another illustration shows the door being filled. A slab, which is both drill-proof and torch-proof, is lowered into the shell or casting. It is a special non-ferrous alloy that has been developed for this special purpose, and will stop both the drill and the torch.

FITTING SAFE DEPOSIT LOCKS

Safe deposit boxes have locks requiring joint action of customer and custodian

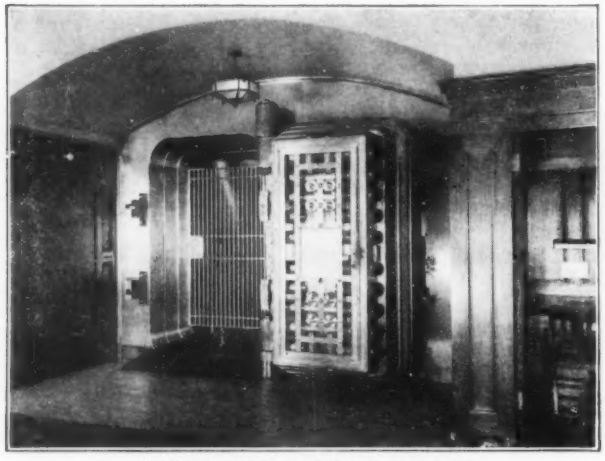
After the various layers are put into the door, the final or boltwork plate is attached. An actuating mechanism and the bolts themselves are set up so that the locking may be accurately performed. The door is then hung on its gigantic hinge, which is attached to the vestibule into which the door swings. The common practice in vault work is to make this hinge twice as strong as is necessary to carry the door's weight without spring or sag, and to facilitate more readily the swinging of this huge weight from the hinge, there are roller and ball bearings used at the necessary points.

Even with the massive type of rectangular door which we illustrate it is necessary for each bolt to be individually adjusted and properly fitted so that all the bolts may take a firm bearing on the jambs when the door is shut, as each one has to do its share in the protection of the valuables within the vault. As might be expected, this requires a high degree of mechanical skill. The plates, bars, and other portions are machined, ground, and then are finally finished with emery and oil, as shown in one of our illustrations. The reason for this is that draw filed steel, carefully polished, presents not only a handsome appearance but shows the least attempt to tamper with the integrity of the vault door or bolts.

The packing and shipping of one of these great doors presents a unique problem since their weight is enormous. The vaults are shipped all over the world—China, Japan, South America, and even sometimes to Europe, where American safes and vaults have always been highly esteemed.

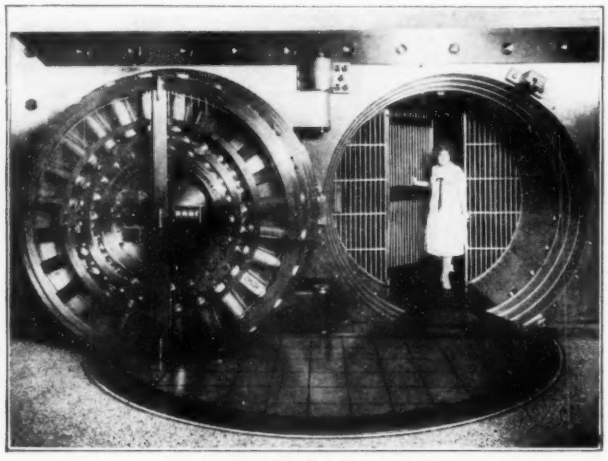
The safe deposit boxes are a part of the work of the vault manufacturers. It is the practice in safe deposit work to use a lock which requires two keys in order that entrance may be gained into the box proper and a tin bond box withdrawn therefrom. Of these two keys, one is called the "guard" or "preparatory" key and is used by the custodian of the vault, being a master key for all the boxes within that vault. The other is known as the "customer's" key and remains at all times in the possession of the customer. Thus it is necessary for both the customer and the custodian to be present with their separate keys every time the box is opened. To be sure that all locks are in perfect working order, they are carefully tested before they leave the vault manufacturer's plant. After testing, the keys are put into a key cabinet for safe keeping.

THE writer is indebted to Mr. Harry H. Lynn, Vice-President of The Mosler Safe Company, Hamilton, Ohio, for assistance in the preparation of the present article, the photographs for which were made under the immediate direction of the writer during a recent visit to the plant. The industry is extremely interesting owing to the masses of metal to be fabricated.



A RECTANGULAR VAULT DOOR

Here we have a vault door of enormous size. The bolts are thrown in one operation. The great hinge supports the door



A CIRCULAR VAULT DOOR

This door weighs thirty tons. Round doors are no stronger than rectangular ones but they have real advertising value

GENERAL VIEW OF THE EXCAVATIONS

The water level was reached at a depth of 50 feet below the original surface of the mound. This was found in the large hole at the left. A few of the basket boys may be seen carrying the earth out of the dump. A section of contractor's light railway is in the foreground

More Light on Sumerian Culture

KISH, in Mesopotamia, was supposed to be the first city built after the great flood of biblical times and therein was established one of the world's very oldest civilizations. See the SCIENTIFIC AMERICAN for March, 1928. Complete evidence of the great flood recorded in Genesis and also evidence of a flood of similar proportions has been recently discovered by excavators. The Babylonian and Hebrew accounts of the deluge are fully confirmed by the findings of the Field Museum-Oxford University Joint Expedition to Mesopotamia, says Professor Langdon. Archeologists of the expedition estimate from the depth of the layer in the excavated site at which the evidence was found, from traces of the damage done by water, and from deciphering inscribed tablets found there, that the flood recorded in the Bible occurred about 3400 B.C. The earlier flood of which the excavators have revealed traces is estimated to have happened some 600 years earlier, at about 4000 B.C. The evidence of the floods is contained in two strata of the ruins of the ancient Sumerian city which now lie at levels about 45 and 55 feet respectively below the surface of the great mound in which Kish was buried. Crushed down through the centuries, the lower stratum now has a thickness of eighteen inches. The expedition workers have bared a length of some 180 feet of this stratum, all of which shows evidence of the earlier flood. These discoveries are regarded as being one of the greatest steps yet made toward reconciling the results of scientific research with Biblical accounts of civilized man's early history.

SUMERIAN ART

The small limestone plaque shows a king trampling on enemies, ranged in two rows

PLUMBING IN KISH

Although these ancients may not have had running water, they at least had good drains and some knowledge of sanitary science. In the background is a pavement with various sized bricks

The Loon Poses For The Camera

Photographs Taken From a Blind at Close Range Reveal the Home Life of this Timid American Water Fowl

By DR. FRANK N. WILSON
Courtesy Bird-Lore

DURING May, 1927, the writer obtained some fairly satisfactory photographs of that interesting bird, the loon, by means of a camera set-up in which the shutter was tripped with a long cord. The results, however, were not wholly satisfactory, and so we determined to make an effort to study this bird at close range the next year.

We made several trips to the shallow lake where our previous studies were made, but we saw nothing of the loons until May 2, when, to our great joy, we saw two birds near a large reed-bed at the east end of the lake. One of the birds soon disclosed the location of the nest and, having secured a boat, we rowed out to examine it.

IN the center of the reed-bed there was a narrow stretch of water, and at the west end of this, 10 to 15 feet from the rim of reeds which screened it, an old muskrat-house, some five feet in diameter, rose six to seven inches above the shallow water. On the east margin of this pile of rubbish, in a slight hollow from which the coarser reeds had been removed, lay the two large, spotted eggs. Incubation had apparently begun some time between April 27 and May 2, and we had ample time ahead for the purpose we had in view.

The water about the nest was not over a foot deep but the soft muck was almost bottomless. It was necessary, if we were to conceal ourselves nearby, to build a blind upon a raft. After considerable computation, involving the specific gravities of lumber, we purchased some pine planks and constructed a platform eight feet square and about five inches thick. In the center of this platform we placed our usual oblong canvas tent and built a strong frame about it. The outside of the frame and the exposed portion of the platform were covered with poultry wire through the meshes of which marsh grass was threaded until the whole looked like a miniature grass house. It was now necessary to proceed with caution; haste in bringing our blind up to the nest might cause the birds to desert and not only waste our labor but injure the nesting prospects of our subjects. Each morning we cautiously advanced it toward our goal until, on May 9, it was only 27 feet from the nest in the shallow water.

We were now ready for photography. The blind lay to the east of the nest so that our work had to be confined to the morning hours. Our usual routine was as follows: We arrived at the lake between 7 and 7:30 A.M., occasionally not until 9 A.M., and after peeping over the ridge to see that all was well Mrs. Wilson rowed me out to the blind. After I had crawled in and set up my camera, she returned to shore and, carefully concealing herself, watched with binoculars. By means of colored handkerchiefs attached to a long stick, which could be thrust out of the back of the blind, I could signal her to come for me or to put the loon off the nest. I was thus able to avoid giving the bird a desperate fright by suddenly appearing nearby.

FEMALE ARRANGING EGGS

The nest affords a convenient island rest for the turtle. The water is a foot deep

Between May 9 and May 28, when the nest was finally deserted, I spent from one to four hours in the blind on 12 different days, and it would be tedious to recount in detail the events which occurred. I shall confine myself, therefore, to a general description of the behavior of my subjects.

I soon observed that the two loons differed not only in appearance but also in temperament. One of them appeared distinctly larger and more strongly built than the other, and had a more massive head and a stouter beak. From the behavior of this bird I concluded that it was the female and shall so refer to it in the remainder of this article. Both birds shared the duty of incubation, but the male was so much more wary than the female that he occupied the nest for an appreciable period only once while I was in the blind. On several occasions, however, he had approached the nest or actually mounted upon it when the sound of the shutter or some other noise in the blind frightened him away. Similar disturbances were almost completely ignored by the female. I am of the opinion that the female ordinarily occupied the nest and that the male relieved her two or three times during the 24 hours in order that she might secure food. Since the birds were disturbed by my operations, I could not determine their exact routine.

The female was usually on the nest when we arrived. When we rowed out upon the lake she retired and waited patiently some 300 to 400 feet away until I had entered the blind and Mrs. Wilson had returned to shore and concealed herself. The loon almost always returned promptly. From the blind I could see her paddling slowly up to the rushes through which she followed a definite course. Even after I had watched her many times my heart still quickened as she came closer and closer. She seldom hesitated for more than a moment until within three to four feet of the nest. At this point, however, she stopped and swam back and forth for several minutes before deciding to go on the nest. Then she swam up to the muskrat house, and, after hesitating but a moment, with a mighty heave pushed her breast up on the rim of the nest. With considerable difficulty she scrambled up, and, taking one or two quick steps, flopped down on the eggs.

A FEW minutes later she invariably rose and, turning around, stood upright, bracing herself with her wings while she adjusted her eggs. While thus engaged, her bill was always partly open, but only the lower mandible was used in moving the eggs which were shoved far back under the lower abdomen. When they were arranged to her satisfaction, she settled down facing the direction from which she had climbed up on the nest, for it was on this side that the margin of the nest was nearest the water.

After she had made herself comfortable, the loon often sat for from two to four hours without changing her position; her head was, however, in almost constant motion. When

Mrs. Wilson came down to the shore and rowed out upon the lake, the loon dropped her head and held it over the rim of the nest only a few inches from the water. She maintained this position as the boat came nearer and finally, raising her wings slightly, she gave a vigorous push with her feet and slid into the water. The distance of the boat from the nest at the time when she left was very variable; at first she was off almost as soon as it had left the shore and swam out through the rushes without diving. Toward the end of the period of incubation she usually remained on the nest much longer, and once or twice did not leave until the boat was within six to seven rods. When she allowed the boat to come close, she dove as soon as she had struck the water and did not reappear until she was some 200 feet away.

LAUNCHING OF THE LOON

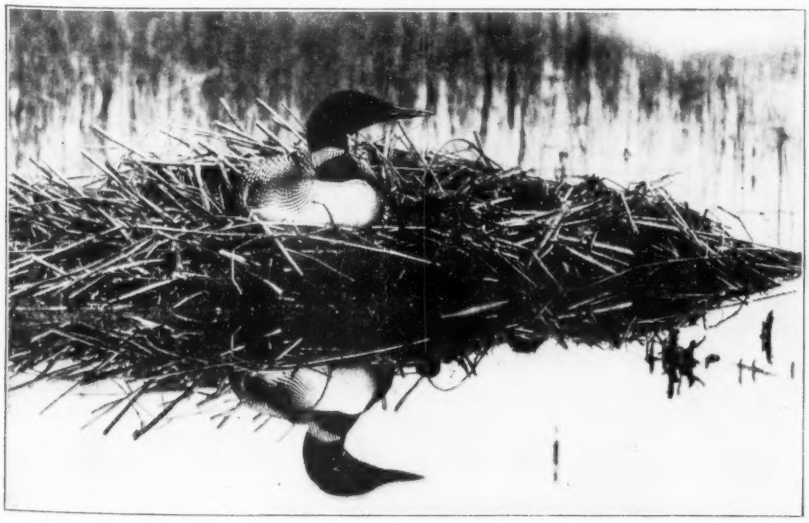
When the young are small the parents abandon their habits of the nesting period and both are seen with the young. During the incubation period, only one parent remains

SOME time during the morning the male usually appeared, and occasionally he was on hand when we arrived. His appearance usually meant that his turn at the nest had come, and I knew that I was in for trouble. I could recognize him a long way off, particularly if both birds were together. In approaching the nest he almost always dove several times, finally appearing close to the rim of rushes some 35 to 40 feet away. He was extremely wary; he would swim toward the nest, suddenly stop, hesitate, and retreat. A few minutes later he would be back again, only to repeat the same performance, and this would go on for possibly an hour. It was most exasperating. On two or three occasions he gave it up and called his mate, who had flown off the lake when he first approached the nest.

After May 20 we began to watch for signs that the eggs were about to hatch. On the 22nd, the female, usually silent, made a great outcry as we approached the nest, otherwise everything went on as usual until the 27th. It was a wonderfully still morning and the lake lay like a mirror in the soft light. The loon complained mildly as we rowed out, and we saw a small, fluffy, black ball in the nest. One of the eggs had hatched. After I had entered the blind the female returned promptly and, after adjusting herself upon the remaining egg, raised her wing and tried to induce the youngster to take shelter under it. The male apparently realized that something important had occurred for he soon came swimming through the rushes and approached the nest. He swam back and forth within a few feet of his mate who cooed to him ever so softly.

During the morning, he made several visits, but finally flew off the lake without disclosing whether he had any special purpose in coming to the nest. When Mrs. Wilson came out with the boat, the female allowed her to approach within a few feet of the blind and then flapped off the nest and, running over the water with wings folded, made a great outcry. The young loon understood and promptly left the nest to join her. They came back to the nest a half hour after we had very carefully concealed ourselves on shore.

In the afternoon we returned to the lake and watched with glasses from the high bank. The two parent birds were out in the middle of the lake with the young one, who sometimes rode on the back of one of them, sometimes swam about near them. Once I thought I saw the male approach the baby and offer it food. After perhaps an hour the female suddenly started for the nest; she swam straight to it, diving a couple of times on the way.



THE MOTHER LOON

A mother loon with a chick huddling closely under her breast, both being reflected in the water. Loons are the most wary and attractive of our native birds and are hard to study

AFTER she had climbed up she spent much time adjusting herself and arranging the reeds about the nest with her beak. The youngster soon climbed on the back of the male and the latter, paddling slowly and carefully, carried him home. When a few feet from the nest he got down and, swimming to the muskrat-house, climbed up to join his mother.

It was a wonderful view of family life in loondom; how I wished that I might have been in the blind to record photographically the return home. I thought that this scene might perhaps be repeated, and the next day I watched from the shore until I saw the female and the young loon leave the nest and join the male. I then cautiously entered the blind. About an hour later the female returned alone as I had expected. Four hours later something frightened her and she left the nest. During all this time, the male and the youngster were having a wonderful time out in the lake. The parent seemed to be giving the young one lessons in diving and in other secrets of loon life.

Pioneering for a Cape to Cairo Highway

A Young Englishman, Driving an American Car, Demonstrates the Feasibility of Establishing a Motor Route Across Africa

By GERRY BOUWER

ABOUT 30 years ago Cecil Rhodes, Britain's greatest imperialist, who was Prime Minister of the Cape Colony at the time, dreamed of one day building a railroad from Cape Town to Cairo. His aim was to build up an African empire for Great Britain, and he visualized the day when Africa would be opened to the world's trade and the world's travelers by a transcontinental railroad.

At that time South Africa was in the early stages of its development. The only existing railroad was from Cape Town to Johannesburg, a thousand miles, and but one eighth of the distance from Table Bay to the Mediterranean. But Rhodes died, and his dream of building up this Cape to Cairo railway has not yet been fulfilled.

TWENTY-SIX years later another British imperialist dreamed of extending British influence in Africa and opening up the "Dark Continent" to civilization. His project was to build a motor highway from one end of Africa to the other. This imperialist is Sir A. Bailey. In a speech which he delivered some time ago, before a distinguished gathering in London, he said that the building of such a road would prove to be the greatest development that could take place within the British Empire.

His declaration aroused world-wide interest. Whole front pages in many African newspapers were devoted to the subject. Soon everyone was talking about the day when the jaded globe trotter would engage a taxi in Cape Town and to the driver give Khartum, Cairo, or Alexandria as his destination.

But in all this welter of excitement no one knew exactly what were the obstacles confronting the building of such a transcontinental highway, and the secrets of Africa's 8000 miles of forests, swamps, and desert were still to be probed by the enthusiastic road builders of modern South Africa. It was to clear up this point that I, accompanied by E. Millin, a journalist on the staff of the Johannesburg Rand *Daily Mail*, set out on the journey from Cape Town to Cairo. In order that our information should be entirely reliable and authentic, we timed our start so that our trip was made in the African wet season and therefore under the worst possible conditions.

We set out from Cape Town on the 8th of February in a Chrysler "72" sedan. Our equipment consisted of a tent, a medicine chest completely equipped with special medicines required in the tropics, mosquito-proof sleeping bags, two rifles, a shot gun, ammunition, and cameras. A month's supply of food was stored away in a box attached to the rear tire carriers. Our food consisted mostly of canned meats and vegetables.

Our route from Cape Town was over the Karoo Plateau to Johannesburg, the center of Africa's gold industry. The road between these two points is fairly good, although of course it is not paved, as are so many of the highways in America. From Johannesburg, which is 1000 miles from Cape Town, the road deteriorated into a mere track which winds through heavily bushed country to the Limpopo River on the borders of Rhodesia. This bush country, which teems with game of all varieties, extends more than 7000 miles to Cairo. On arrival at Bulawayo we had reached our last outpost of civilization. Northward from there was nothing but dense African forests with only native paths for a road. Three hundred miles north of Bulawayo are the Victoria Falls, which are famed throughout the world. Our journey to the falls was made without incident with the exception of a meeting with a very interesting hermit and a herd of elephant that very nearly caused an untimely end to our expedition.

TRAIL-BLAZERS

Gerry Bouwer, with his wife, upon completion of the 8000-mile journey over what may some day be a very busy highway

From the Victoria Falls we journeyed to Broken Hill in northwestern Rhodesia. Before reaching the Victoria Falls we encountered no great difficulty in driving, but once having crossed the Zambesi River, we found ourselves in a quagmire which extends many miles northward to the desert sands of the Sahara. The rainfall in this country averages nearly 100 inches a year, and this terrific downpour is confined to three months of the year. Frequently we did not average more than two miles a day. It was necessary literally to build a road of "corduroy" through the forests.

Fortunately, the natives living in this part of the country were friendly, and in return for a teaspoonful of salt per man we were able to gain the services of gangs of several hundred natives. These gangs were employed in cutting down trees, which were afterwards laid over the ground to form a solid track for the car. The natives were but scantily clad, and when we first met them we were greatly embarrassed to find women and girls in a state of nudity perfectly willing to earn their salt by helping to extricate the car from the morass. After floundering through these flooded forests for several weeks we became quite used to African dress fashions and were not disturbed when whole villages turned out to greet us arrayed in their birthday suits.

FROM Broken Hill we followed native tracks to the southern end of Lake Tanganyika, passing enroute the spot where Livingston died. Constant heavy rains still made our progress extremely slow and difficult, and we relieved the tedium of digging the car out of one bog after another by hunting the game which abounds in this territory. In the beginning we were thrilled to shoot small game such as antelope, but after a few weeks we became bolder and turned our attention to elephant and buffalo. One day our expedition nearly came to grief, through my folly in hunting elephants in a herd. This narrow escape occurred, curiously enough, on the very spot where Captain Kelsey, who had attempted to

drive an automobile from Cape Town to Cairo in 1913, had been killed by a leopard.

From Lake Tanganyika our route was through Tanganyika Territory to Nairobi in Kenya Colony. We had now arrived in Central Africa proper. We set out one night from Dodoma, a railroad station on the Central African Railroad, for Arusha in an attempt to cover 400 miles in 24 hours. It was necessary to make this journey, for we were fearful of running into further rainstorms. All went well until after dark, when we became bogged in a patch of black cotton soil.

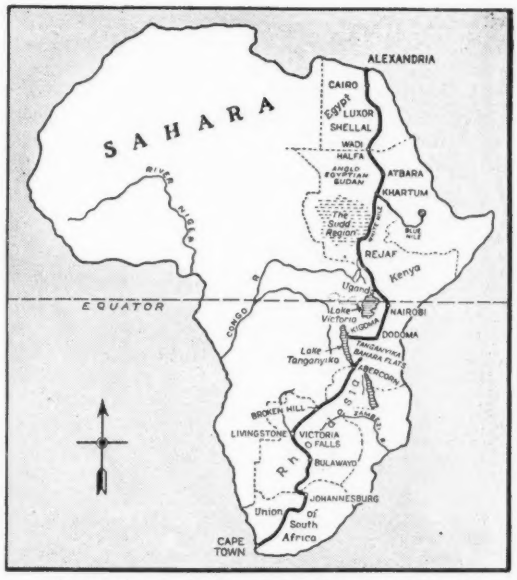
FEVERISHLY we set to work to free the car from the clutches of the mud and paid little attention to the cries of African night life which were coming from all directions. But after a while we could not fail to realize that we were more or less encircled by a troop of animals. Brightly shining eyes reflected the light from the car's headlamps, and every now and then these eyes would approach closer and closer to the scene of our operations. After a while I decided to investigate and connected up the spot-light, throwing its beam into the surrounding bush. The moment I pressed the switch I saw that our visitors were lions which were moving stealthily through the bush, gradually creeping closer to the car.

My first thought was to grab my rifle and shoot, but, remembering my experience with the elephants, I decided that discretion was the better part of valor, and turned off the lights. There was nothing for it but to go on with our digging and pretend that we hadn't seen the lions. I do not know if this attitude disturbed them, but the fact remains that after giving vent to a roar of disapproval they disappeared. Had I fired my rifle there is little doubt that they would have charged.

An added danger of travel in this country is the presence of numerous rhinoceros. It is quite generally known in the bush that this clumsy relic of prehistoric times is probably the fastest animal on earth over a hundred yards. Several men have been killed by rhinoceros while driving through the bush. Having been told of these accidents we kept a very wary eye for these animals. On the only occasion on which one showed up, we were able to get away from any possible attack by using all the speed of the car.

Close to Nairobi we passed the foot of Mount Kilimanjaro, Africa's highest mountain, 20,000 feet above sea level, and we found this section of country to be one of the most interesting in all our journey. At the foot of this mountain range are the Masai Plains, which have been closed to hunters for many years, and are now covered with almost every species of game to be found in Africa.

From Nairobi our route was through Uganda to the lower regions of the River Nile. The roads in this vicinity are good, indeed the best in Africa, and we found no great difficulty in covering the 800 miles. Close to the road are the wonderful Inturi Forests, the home of the gorilla and the African pigmies. We made a special journey to these forests and were greatly disappointed to find that the pigmies are very timid and are seen very infrequently by white men. However, there is no doubt of their presence, and in making one's way from the dense jungles one frequently hears a strange murmuring from the tree-tops. These pigmies are adept at hiding in the jungle, and one can pass within two or three feet of them without being aware of their presence. We saw several gorillas but did not have the opportunity nor time to stop and make a killing.



ROUTE OF CAPE TO CAIRO JOURNEY

During the dry season, the journey can be made by the adventurous, as proved by Bouwer's experience

Having arrived on the banks of the Nile we found ourselves confronted with an enormous swamp extending for 1100 miles to the north. This region is known as the "Sudd" and the only means of crossing over these swamps is by the Nile River boat, which we were forced to take. The journey through the swamps to Khartum occupies 16 days and is one of the most monotonous of all African travel routes. For days we saw nothing but miles and miles of papyrus grass floating in the swamps.

NOW and then this tedium was relieved by a stop at an island. These islands are populated by the most primitive native tribe in Africa. Their teeth are filed to sharp points and there is little doubt that they practice cannibalism. No crops are grown and they subsist on milk obtained from huge herds of cattle which they maintain somehow or other on their small islands. Clothing of any sort is nonexistent and they are not amenable to any sort of control by white men. The Sudan Government maintains magisterial outposts in the Sudd, but every now and then a magistrate is murdered by these natives. They have the peculiar and comical practice of standing on one leg, like a stork.

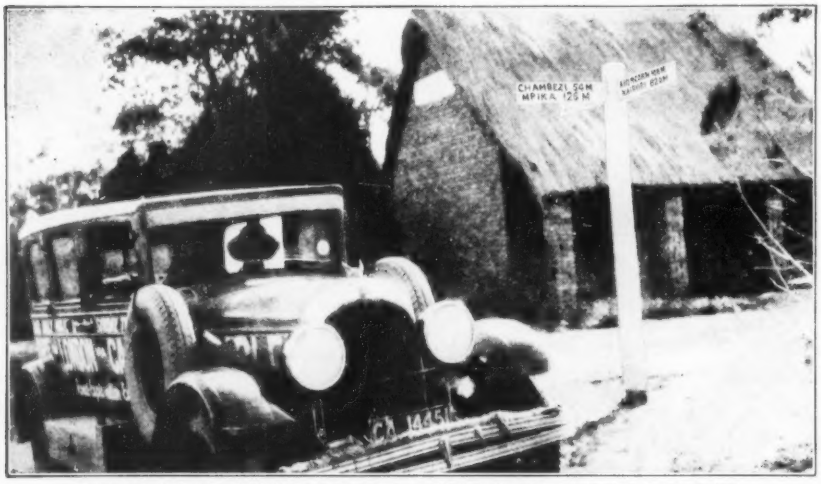
At Khartum we disembarked and prepared ourselves for our journey over the desert to Cairo, 2000 miles away. There is no track whatsoever from Khartum to Cairo, but we had the option of following either the Valley of the Nile or what is possibly the oldest camel route in the world—"The Road of Forty Days."

Unfortunately, however, whereas the camel loves nothing better than deep sand, such a surface is more or less impossible for a motor car, and we were

Courtesy African Films, Ltd.

CROSSING THE LIMPOPO DRIFT IN SOUTHERN AFRICA

Only by co-ordinating horsepower, mule-power, and man-power, were the adventurers able to cross some of the streams and swamps encountered when traveling in the rainy season



SYMBOL OF AFRICA'S RAPID COMMERCIAL DEVELOPMENT

In the rainy season, the trip to Cairo took 94 days; the return trip to Cape Town was made in 40 days in the same car, and over practically the same route but during the dry season

forced to follow the Valley of the Nile, making our way as best we could through the ironstone valleys. On one occasion we became lost in the Wadi el Homer and for many blistering hours tramped over great ironstone boulders, seeking a passage for the car. Ultimately, when we were on the verge of despair, we happened upon an Arab caravan which was journeying over the desert to Berber on the Nile. After much gesticulation and the frequent turn-over of our entire Arabic vocabulary we got the leader to understand that we were lost.

Forthwith he led a wild exit straight over the hills to the east, over boulders and along gullys. Time and again in making this journey across the hills we were confronted with what appeared to be unsurmountable obstacles and there was nothing to do but to head the car down an almost sheer drop into a deep gully, depending upon the momentum thus gained to carry the car over the patch of heavy sand in the water course, and then climb the opposite bank. Finally we reached a fairly well defined camel track with a sandy surface, leading to Cairo.

ON my return in the dry season, I planned to do the trip on a schedule of 40 days from Cairo. It was my intention to do this alone, to save space and extra weight. But as my wife—I am newly wedded—had joined me, she insisted on accompanying me on a rather wild drive to establish a speed record for the length of the continent.

Leaving Cairo, we covered Egypt from one end to the other in 24 hours. Then we crossed the Nubian desert, a distance of 600 miles, in three days. We raced the Sudan express from Wadi Halfa to Abu Hamed across the ironstone desert, with the temperature at 120 degrees in the shade. At Khartum, rather than make a detour through wastes of desert, hundreds of square miles in extent, we took portage across 800 miles of the Sudd swamp, consuming 16 precious days. From Mongalla, at the other end of the swamp, another 13 days were used in traversing the 500 miles through the dense African bush.

On the final lap from equatorial Africa to Table Bay, we almost encountered disaster going over a bridge rotted by torrential rains. It was collapsing under us, but by using terrific acceleration we got across as the bridge fell. Speeding on south, we reached Uganda, Kenya, and Tanganyika. The fourth day thereafter we were in northern Rhodesia, and found that the whole continent was showing keen interest in our dash.

The next day while fighting through a section of the country that was gripped in a bush fire 50 miles wide, the car caught fire and the trail of dust starting at Cairo all but ended in smoke. I was able to extinguish the flames, but found it necessary to rewire the engine and lamps, causing a loss of 24 hours. During the halt, I learned that the bush fire had been started by a native tribe trapping a herd of elephants for food, making a ring of fire about the herd.

Two days later we reached Victoria Falls, with only five days left to cover the 2500 miles to Capetown. I was breaking under the strain, and once fell asleep at the wheel. The car crashed into a gully, smashing the front spring. This was quickly repaired, and we proceeded on to the Limpopo River, and crossed into the Union of South Africa. At Johannesburg, the whole city turned out to greet us. Normal business was suspended by thousands interested in our journey. We reached Capetown just 27 minutes beyond the 40-day limit, and came to a stop at the statue of Van Riebeek, founder of South Africa.

I HAD made the round trip and showed it could be done by any reasonable-minded motorist. The conclusion to be drawn from my experience is that the Cape to Cairo road is practically impassable during the rainy season, and must remain so for many years. But during the dry season, the journey can be made by the adventurous, without necessitating too large expenditures in building the world's longest motor route.

In gathering the stock of information necessary to formulate plans for the proposed highway, the foundation has been laid for a new bond which will link the ancient cities of the Nile Valley with the rapidly developing Union of South Africa. In the last 20 years it has been demonstrated that adequate facilities for motor transportation are superior to railroads in opening up undeveloped regions. The natural development of the continent demands a great trunk highway extending from Alexandria to the Cape of Good Hope. Such a project is feasible.

MUD—A MAJOR PROBLEM IN TRANS-AFRICAN TRAVEL

Digging the car out of the mud became a habit while traversing the native trails in the African bush during the season when almost all travel in equatorial regions is suspended

A NEAT TYPE OF LIGHT PLANE

The Driggs *Skylark* is called by its manufacturers the "personal plane." Powered with a 60 horsepower Rover engine with inverted in-line cylinders, it is said to have a top speed of 110 miles per hour, and it is claimed that it can climb at a rate of 900 feet per minute

Last Call For Light Airplane Design Contest

THIS is the last notice we can give editorially to those who wish to enter our Light Plane Design Contest as August 15th is the dead line for the submission of designs. All drawings and data eligible for the prize must be in the hands of the Committee on that date.

Sixty-eight signed entry blanks have been received at the time of writing. Should any of the remaining seventy-six to whom have been sent the cowling and engine mounting drawings, et cetera, desire to participate, they should take notice that the signed entry blank must be sent at once, so that plans can be made to cope with whatever number of entries there may be.

Among the entrants it is of interest to note that a majority of the large aircraft builders are represented by some member of the organization; most of the prominent aviation schools, both technical and practical, have entrants from men in the junior class up to the Dean of the school. Another significant fact is that an unusual number of entry blanks have name and address printed in lettering which is rather indicative of the fact that the writers have had experience in mechanical drawing.

Supplementing these of course are indicated entrants from all sorts of trades and professions, the total of which makes one ponder upon the wide practical interest of the many outside the realm of aviation business. Surely here must be found the amateur enthusiast who makes up a large part of the ever widening circle for whom the benefits of this contest will have a more particular meaning.

The gold, silver, and bronze medals made by The Gorham Company are especially beautiful examples of the medallic art and with the cash prize of 500 dollars make a reward of sufficient worth to stimulate the interest of professionals as well as amateurs. Then too there is the possibility of the winning designs being acquired for manufacture, which incentive may in the long run be rewarded by an emolument to the designer far beyond the value of the prizes themselves.

It is plainly evident that the success of this contest for light airplane designs is assured.

THREE MEDALS TO BE AWARDED

Besides a cash award of 500 dollars, the first prize winner will be presented with a gold medal such as that shown. Second best design will receive a silver and third a bronze medal

The Home of the Honey Bees

Nature's Nectar Collectors Exhibit Rare Skill in Constructing Their Waxen Combs

By J. H. MERRILL, Ph.D.

"GO to the ant, thou sluggard, consider her ways, and be wise," counseled King Solomon. He was speaking to sluggards. Had he been addressing students in architecture he probably would have said, "Go to the bee, thou student, consider her ways and be wise," for no more marvelous example of architectural skill exists than that product of the bees, the honeycomb.

Yet, how many people enjoy comb honey because they "like the taste of the wax," or ever give a thought as to how this waxen comb is made? Do they believe that it is a product of man's ingenuity?

A beekeeper once submitted the following problem to a prominent mathematician. "What would be the size of the angles of a cell which would give the greatest amount of strength, and, at the same time, require the least amount of wax?" The mathematician's answer called for a six-sided cell with angles which varied but a few seconds from those used by the bees.

AN ordinary bee hive consists of a box, called the brood chamber, in which there are a number of wooden frames filled with honeycomb, where it is intended that the brood, or young bees, shall be reared. On this brood chamber are placed other boxes or supers, containing comb, in which it is hoped that the bees will store honey. While at first glance one is impressed by the seeming exactness of these neatly appearing rows upon rows of cells in these combs, upon closer examination it will be found that their exactness is more apparent than real.

When France was about to adopt the metric system of measurement, it was suggested by Reaumur, one of her most famous scientists, that the cell of the honeycomb be used as a unit of measurement. Had France adopted his suggestion it would surely have resulted in chaos. Each caste of bee requires a cell of particular size, and close measurement will reveal the fact that there is even a slight difference in the size of the cells allotted to members of each caste.

The largest cells in the brood frame, measuring about four to the inch, are the ones in which the queen deposits infertile eggs, which later develop into drones. Her fertile eggs are laid in smaller cells measuring five to the inch, and these become worker bees.

THINGS which yesterday were hidden from the view and knowledge of man are now becoming more and more apparent every day. Some day we may know why a queen bee deposits fertile eggs in worker cells and infertile eggs in drone cells, but with our present limited knowledge, we cannot hazard even a respectable guess.

Drones and workers have their lives directed along different lines from the very start. The workers, Cinderella-like, are reared in modest, flat-roofed cells, while the lazy drones luxuriate in larger and more ornate Gothic-roofed cells. Lying between the worker and the drone cells are irregular-shaped or transitional cells. When the bees desire to raise a new queen they pay deference to royalty by building for her a large, peanut-shaped castle, placed at right angles to the other cells.

In the well ordered routine of the bee hive we find not only conservation of energy but of building material as well. This is typified by the fact that the cells of the honeycomb are used not only as chambers in which the eggs become transformed into adults, but also as storehouses for food. Honey is stored in cells regardless of their size, with a preference, if any, given to the larger size, while the worker cells are used as storehouses for pollen. There is no necessity for keeping pollen airtight; consequently, these cells are left open, but honey and brood require covering. Wax is used to cover the honey cells while a more porous material, which will permit the passage of air, is used over the brood.

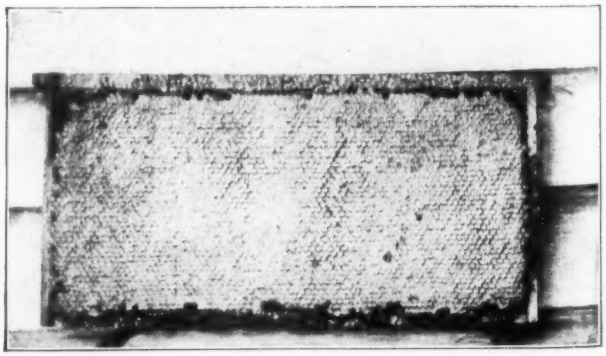
Bees gather nectar and pollen from the flowers, but the wax which they use is produced by their own bodies. The body of the bee is divided into three parts, the head, thorax, and abdomen. The abdomen may be distinguished from the other segments of the body by the fact that it is the one which carries the sting. On the under side of the abdomen are eight small plates, which are sometimes called mirrors, or waxplates, and it is through these little plates that all of the wax used in the hive is excreted.

THE making of wax and the building of the comb are two of the most interesting duties which bees perform. Wax makers are like poets, in that they are born, not made, and they resemble them also by following their calling only under favorable conditions. Bees perform different duties at different periods of their existence. As wax producers they are most efficient during the third week of their lives.

All photographs courtesy *American Bee Journal*

HOME OF THE WAX MAKERS

Man provides the habitat for workers, drones, and queen bees; the workers pay the rent by producing both wax and honey

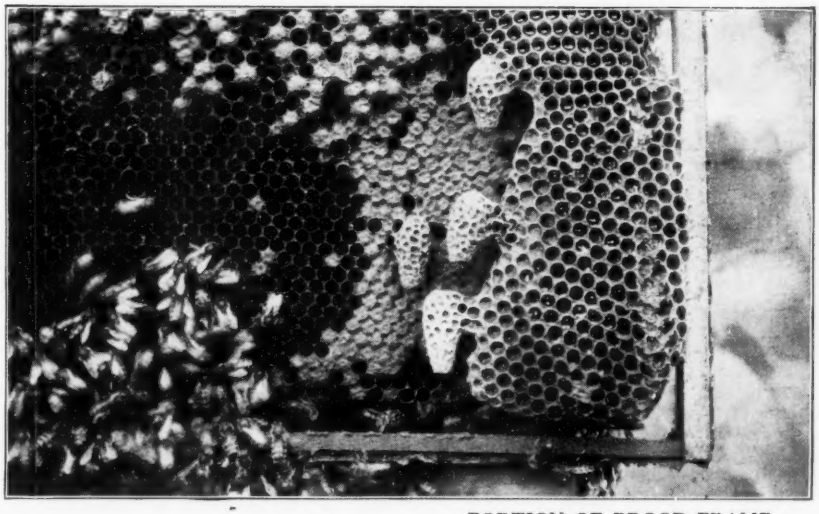


FRAME FROM THE BROOD CHAMBER

For some reason unknown to man, the bees cover the frames with curtains of wax. This wax is then used to construct the honeycomb

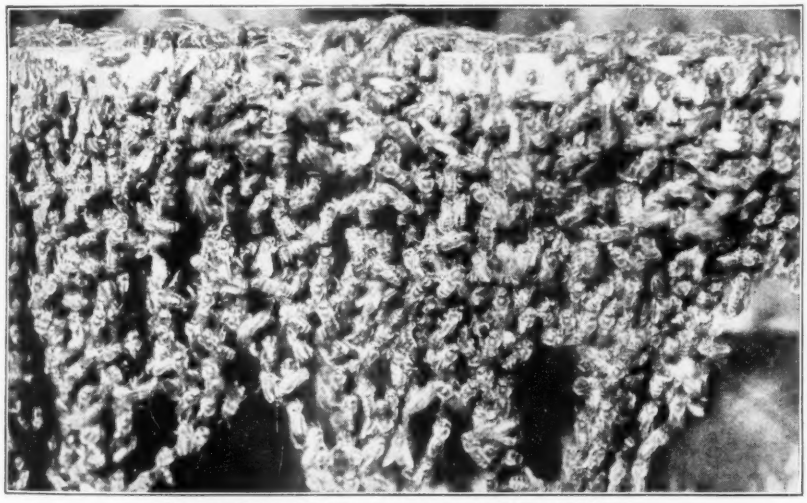
Other conditions necessary for the production of wax are that the hive be warm, and that the wax-producing bees be well filled with honey. When the stage is thus set for wax production, the curtain, instead of going up, goes down. What is still more interesting, this curtain is made up of living bees. Gymnasts, when scaling a wall, mount up on one another's shoulders until the top of the wall is reached, but in forming a wax curtain the bees reverse this process.

First, a row of bees attaches itself to the top of the hive, or frame, then other bees grasp their hind legs, and they in turn are seized by still other bees. This continues, until a series of chains of living bees are festooned across the frame. In about 24 hours the honey within their bodies is transformed into liquid wax, which is excreted through the wax glands, and appears on the wax plates. It then hardens into a thin sheet which the bees loosen with their feet.



PORTION OF BROOD-FRAME

This picture shows cells, capped and uncapped, for queen, workers, drones, and wax



WORKERS BUILDING THE CURTAIN OF WAX

Like an inverted team of tumblers, the bees cling to each other, until bee-chains are festooned over the whole frame. This entire process is described in detail in these columns

It would appeal to the imagination if we could feel that the bees did this in response to a need for wax to be used in comb building. As a matter of fact, however, whenever bees of a wax-producing age, filled with honey, congregate in masses, wax is always produced. Why they form the wax curtain is another of the mysteries of the hive.

AFTER the wax producers have loosened the scales of wax with their feet, the scales fall to the floor, are passed forward to the bees' mouths, or are taken by other bees. These bits of wax are then chewed into a finely granular condition, and carried to the place where the comb-building is going on. They are then laid on the edge of the comb. After depositing the wax the bees scurry away, and other bees bring more wax until finally the comb seems to grow out of nothing.

The only three figures possible for the cells to assume in order to be equal and similar, without any useless spaces between, are the equilateral triangle, the square, and the regular hexagon. It is out of the question for an insect with a round body to build a triangle. A circle would be easier for them, and that is what they really try to build. As each circle touches the other, thick places are formed, and it is in the thinning down of these thick places that the circle becomes transformed into the hexagon.

The bottom of each cell is formed of three lozenges; each lozenge forms one third of the bottom of three opposing cells. Again this is a fortunate arrangement for the bees, but it is not as originally planned. They first try to make each bottom convex, and in so doing they make the bottom of the opposite cell concave. The thinning down of thick places again results in the flat-shaped lozenges.

As the bees continue to draw out the cells they maintain at all times a thick rim on the outer edge of the cell, making it possible for them to work without breaking down its fragile walls. The bees rush here and there, now carrying a piece of wax, now patting it into shape, giving a pinch here and a pinch there with their mandibles. They pause but momentarily, and, apparently, have no regular plan of action. The wonder is that out of all this chaotic confusion is evolved a matchless piece of workmanship.

MAJOR R. W. G. HINGSTON, in his recently published book, "Instinct and Intelligence," presents many interesting observations regarding insects of various kinds, including bees. In seeking to discover the origin of their remarkable instincts, he points out that deliberate efforts or actions begin by some intelligent process, and such efforts may become so habitual as to seem almost automatic. Major Hingston cites Darwin's observation, "If we suppose any habitual action to become inherited—and I think it can be shown that this does sometimes happen—then the resemblance between what originally was a habit and an instinct becomes so close as not to be distinguished."

It is remembered that any evolutionary process of this kind is subject to the laws of natural selection. If the "instinct" is useful, it will develop; if it is harmful, it will disappear. Instinct, apparently, is an outgrowth of certain deliberate acts of intelligence. In the insect the force of instinct has been developed, as in man the power of reasoning has been developed. Each has brought his own type of development to an amazingly perfect degree, although their evolution has carried them along widely divergent paths.

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

A Bird's Companionate Marriage

AN example of successful companionate marriage among the birds is offered in the life of the rhinoceros hornbill, a large and peculiar bird which has a grotesque sort of beauty, and is native to the Malay Peninsula, Borneo, and Sumatra.

The nesting habits of this bird, which are the subject of an exhibit in the systematic bird series at Field Museum of National History, are extraordinary, according to Dr. Wilfred Osgood, curator of zoology. After pairing, the hornbills select a hollow tree which the female enters. Then, with the assistance of the male, who remains outside, the female walls up the entrance with mud and other materials until only a small slit is left open through which she can thrust her long narrow bill. During the entire period of laying and incubating the eggs, and the growth of the young to the flying age, the female remains imprisoned in the trunk. The male, free on the outside to do as he pleases, remains faithful to his mate, returning frequently with food which he deposits in her bill through the slot in the tree, and otherwise assiduously attending to her needs.

This peculiar habit is undoubtedly resorted to as a protection for the eggs and young from the marauding squirrels and monkeys which abound in the tropical forests, says Dr. Osgood.

Vast Supply of Anthracite Chokes Rivers

ENOUGH hard coal to supply the demand of the entire United States for anthracite for 10 years—900,000,000 tons of it—lies in banks and bars which choke the valleys of three rivers in Pensylvania, according to a recent report from the Geological Survey of that state.

These figures are not an official estimate, for it is impossible to estimate with any degree of accuracy, but they are a guess which may be accepted, for they are based upon a close observation of the region traversed by these rivers, and upon data compiled showing the amount of coal continually escaping from the mines.

Coal has been accumulating in the creeks and rivers draining the hard coal region since anthracite mining began on a commercial scale a century ago. It is washed from the waste piles of the collieries, which in the old days of mining were the repositories of all the coal that was not of marketable size. These old culm piles, as they are called, contain from 40 to 80 percent pure coal, some of which is chestnut size.

Another and even greater source of coal from the rivers has been the water from the breakers at the collieries. This water carried with it all the coal that passed through the screens at the mine, and for years it was flushed directly into the creeks. There it formed bars and banks that were washed by the force of floods or freshets a little farther down the stream each year.

The male rhinoceros hornbill outside his sealed nest. The female's beak protrudes through the slit

A flourishing coal salvage business in which nearly 40 companies employing between 400 and 500 men are engaged, has grown up from this coal, and three quarters of a million tons worth nearly a million dollars are recovered from these rivers each year.

The coal, however, is not of the proper size for domestic fuel. It is used by public service companies who have equipped their plants with special grates for burning powdered coal.

The industry has its center in and around Harrisburg, Pennsylvania, on the Susquehanna River, but coal is also being salvaged from the Schuylkill and Lehigh Rivers. A million and a quarter dollars are invested in dredging equipment for reclaiming coal from these rivers.

The river coal industry is now nearly 40 years old, but the experts who made the survey believe that it will last only 25 or 30 years longer at the present rate of recovery.

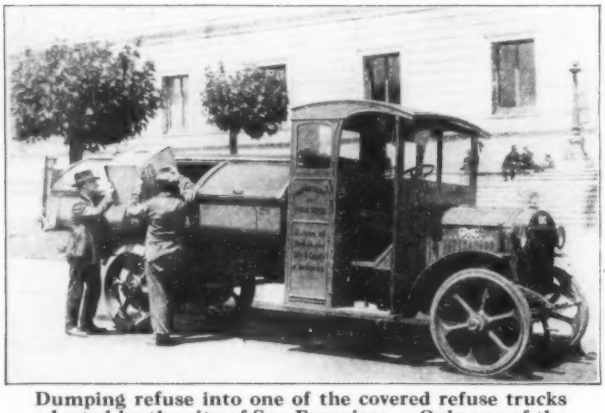
The coal mines no longer waste such tremendous quantities of anthracite as they once did. They have installed expensive machinery that separates practically all of the fine coal from the breaker water, and they are either re-working their old culm piles, or leasing them to reclaiming companies. Briquets and processed coal products are made from the fine coal recovered, or it is sold to public service companies.

But despite the efforts of the coal companies, 1,150,000 tons of coal are still escaping into the rivers each year, the survey men estimate.

The mines are 100 or more miles above Harrisburg, and it is estimated that nearly 30 years are required for the coal from the mines to reach that city. But the long time in the water does not injure it in any way, or destroy its heat value.

Sanitary Bodies for Street Cleaning Trucks

THE old unsanitary and unsightly method of removing sweepings from city streets has been entirely eliminated in San Francisco by a large fleet of specially designed trucks. These trucks are equipped with covers in three sections on each side of the central rib. One or all of the covers on either side may be pushed backward



Dumping refuse into one of the covered refuse trucks adopted by the city of San Francisco. Only one of the doors is opened, the others serving to retain the dust

With all the cover doors closed, the body of the truck is tilted up when dumping is necessary. Fully loaded the truck does not scatter clouds of dust in city streets

in a curved frame so that sweepings may be dumped within the body and the cover slid back into place to prevent blowing of the sweepings from the truck to the street.

The cab of these new trucks is built especially low so that the two men who accompany it may rapidly move from each group of refuse cans to the next. In this cab is a special compartment for carrying raincoats and hats so that in case of rain there need be no delay in the collection of refuse.

In certain sections of the city the street sweepers place the refuse in square metal cans while in others the refuse is left in piles in the street so that the street cleaners may shovel it directly into the trucks. Racks on the side of the trucks carry special shovels for this purpose.

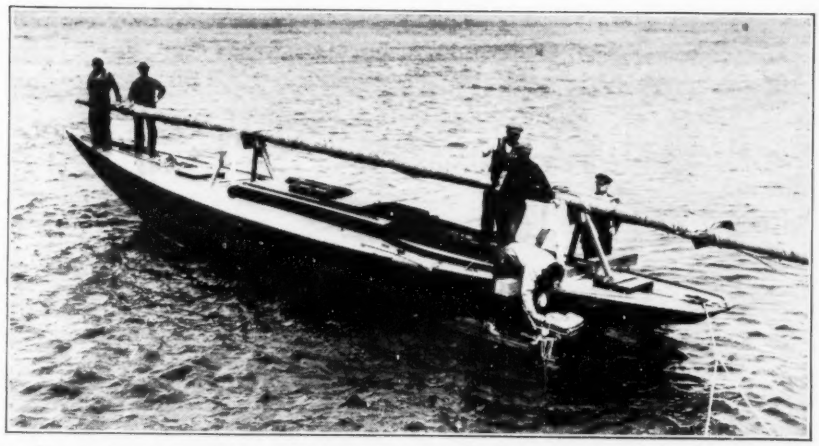
By the old open top truck method, only four to six yards of refuse could be handled daily but by use of the new trucks 15 to 20 yards are handled daily by each truck. Each night the truck body and top are thoroughly washed down by hose.

The special bodies were designed by Mr. Peter Owen, Superintendent of the Street Cleaning Department of the Department of Public Works of San Francisco, who is in a position to arrange with other cities for the use of his sanitary truck body.

Ice Aids in Engineering Jobs

ONE would hardly expect to find construction engineers using ice and sunshine to carry on part of their work but in at least two instances these agents have performed valuable services for the engineer. Strange as it may seem, they have been used successfully to do the work of jacks which could not be used due to certain limitations.

In the first case an orange grower of California wished to lower a large steel tank upon a concrete foundation that had been built for it. Since it was to rest directly on the concrete no jacks could be obtained which would lower it and could then be removed. The orange grower had an inspiration. He drove to the nearest town and surprised his men by returning in a short time with several blocks of ice all cut the same size and shape. These were placed at regular intervals around the foundation and the tank lowered on to them by means of jacks. In a few hours



It was impracticable to attempt to sail this yacht through inland canals or to ship it by train; therefore two outboard motors were used to propel it

slab which formed the floor of a bandstand on the municipal pier. The slab was to be lowered 18 inches and the engineers' problem was to utilize a six-inch space between the floor and the desired level. As in the first case, screw jacks could not be used since they could not be removed after the concrete was in place. The engineers then hit upon the idea of using ice and, as several negroes armed with long-handled mops took care of the water from the melting ice, the slab gradually settled into its new position.

Yacht Transported by Outboard Motor Power

THE *Margaret F-IV*, racing yacht owned by Lawrence P. Fisher, well known Detroit automobile body builder, recently demonstrated the latest wrinkle in marine transportation when she left City Island, New York, for Buffalo, via the Erie canal, her sole power coming from two outboard motors lashed to opposite sides of her afterdeck.

When Mr. Fisher decided to remove *Margaret F-IV* from New York to Detroit, he was beset with the problem of transporting the craft between the two ports. The hull was too high to ship by rail, too expensive to tow, and too awkward to attempt to sail, particularly through the locks and canals. So he solved his difficulty by having two big timbers bolted across her after overhang, one across the deck and the other under her counter. Then he had two Seahorse outboard motors hung on each side of this improvised outrigger.

The masts were cradled on the deck, it being Mr. Fisher's intention to rig up the craft at Buffalo and sail her up the lakes to Detroit, her new home port.

Do Any Scientists Deny Evolution?

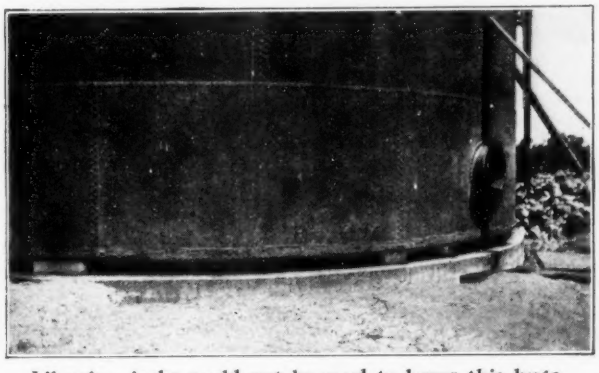
ALTHOUGH readers of the SCIENTIFIC AMERICAN mainly accept evolution as an established principle, many of them must have had occasion to discuss this argumentative subject with persons who reject it. Many of the latter group delight in repeating the fallacious statement that "the real scientists do not themselves longer believe in evolution."

Of those who repeat this absurd statement the majority are doubtless beyond hope of conviction, and time spent discussing the subject with them is a total loss. Others, however, have sincerely been misled into the belief that there actually is a broad cleavage between the scientists who accept evolution and those who do not. To these our readers may find it advantageous to show the statement quoted below.

This statement is official. It proceeds from the Executive Committee of the Council of the great, all-inclusive American Association for the Advancement of Science. This association takes in all branches of science and includes virtually the entire personnel of the professional scientists of the nation. The statement follows:

"*Inasmuch* as the attempt has been made

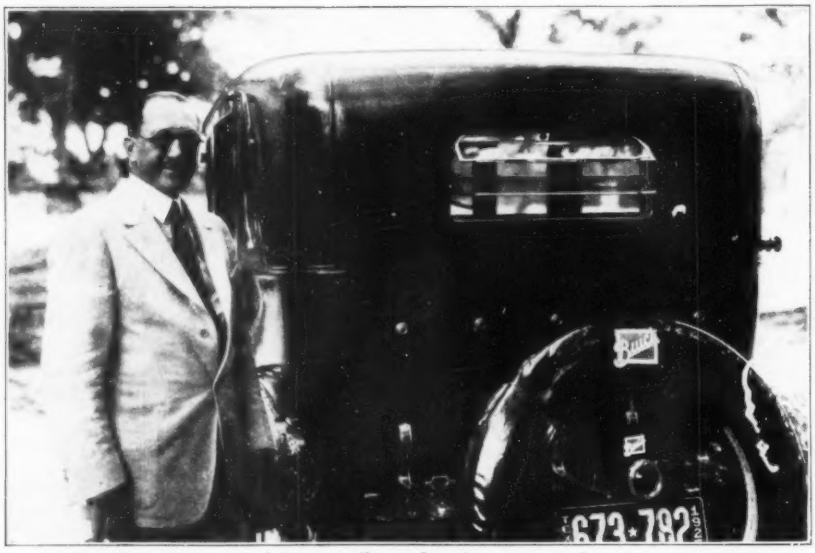
Great blocks of ice, placed under a concrete floor that had already been cast provided the best method of lowering the slab. As the ice melted, the slab settled



Likewise, jacks could not be used to lower this huge tank on to the foundation that had been built for it, because jacks could not be removed. Ice was used

the ice had melted away, leaving the tank firmly and securely upon its foundation.

In the second case engineers of the city of St. Petersburg, Florida, were faced with the problem of lowering a 16-ton concrete



Dr. David R. Taylor and his ventilator for the rear windows of automobiles

in several states to prohibit in tax-supported institutions the teaching of evolution as applied to man, and

"*Since* it has been asserted that there is not a fact in the universe in support of this theory, that it is a 'mere guess' which leading scientists are now abandoning, and that even the American Association for the Advancement of Science has approved this revolt against evolution, and

"*Inasmuch* as such statements have been given wide publicity through the press and are misleading public opinion on this subject.

"*Therefore*, the Executive Committee of the Council of the American Association for the Advancement of Science adopts the present resolution, which is a reaffirmation of the resolution adopted by the council of the association at the fourth Boston meeting, December 26, 1922, in order that there may be no ground for misunderstanding of the attitude of the association, which is one of the largest scientific bodies in the world, with a membership of more than 13,000 persons, including the American authorities in all branches of science. The following statements represent the position of the council with regard to the theory of evolution:

"(1) The Council of the Association has affirmed that so far as the scientific evidences of the evolution of plants and animals and man are concerned, there is no ground whatever for the assertion that these evidences constitute a 'mere guess.' No scientific generalization is more strongly supported by thoroughly tested evidences than is that of organic evolution.

"(2) The Council of the Association has affirmed that the evidences in favor of the evolution of man are sufficient to convince every scientist of note in the world, and that these evidences are increasing in number and importance every year.

"(3) The Council of the Association has affirmed that the theory of evolution is one of the most potent influences for good that have thus far entered into human experience; it has promoted the progress of knowledge; it has fostered unprejudiced inquiry, and it has served as an invaluable aid in humanity's search for truth in many fields.

"(4) The Council of the Association is convinced that any legislation attempting to limit the teaching of any scientific doctrine so well established and so widely accepted by specialists as is the doctrine of evolution would be a profound mistake, which could not fail to injure and retard the advancement of knowledge and of human welfare, by denying the freedom of teaching and inquiry which is essential to all progress."

Ventilator for Rear Window of Car

THE trend of automobile design of recent years has been toward the closed model, there now being in use far more of this kind than of open models. The problem of ventilating closed cars has been given a great deal of attention by designers due to the fact that cases of death by monoxide gas poisoning have occurred because of lack of proper ventilation. Besides this it is a well-known fact that the air within a closed car during the winter months is usually quite foul and disagreeable.

A dentist of Fort Worth, Texas, Dr. David R. Taylor, has recently patented one of the most practicable rear window ventilators that has come to our attention for some time. It consists of a metal frame which is to be mounted in the rear of automobile bodies to take the place of the fixed window glass which is ordinarily used. In this metal frame there are two plates of glass, the upper one being supported by a metal flange which extends across the top and sides and the lower one being supported by metal flanges on each side. These two are adjustable very much in the same manner as are ordinary windshields. Adjustment is affected by means of a rod which is raised or lowered to tilt the glass plates outward or to close them.

Use of this device allows perfect ventilation of the car during cold weather without creating drafts as would be the case should the front windshield or the side glasses be opened.

An Aid to Irrigation

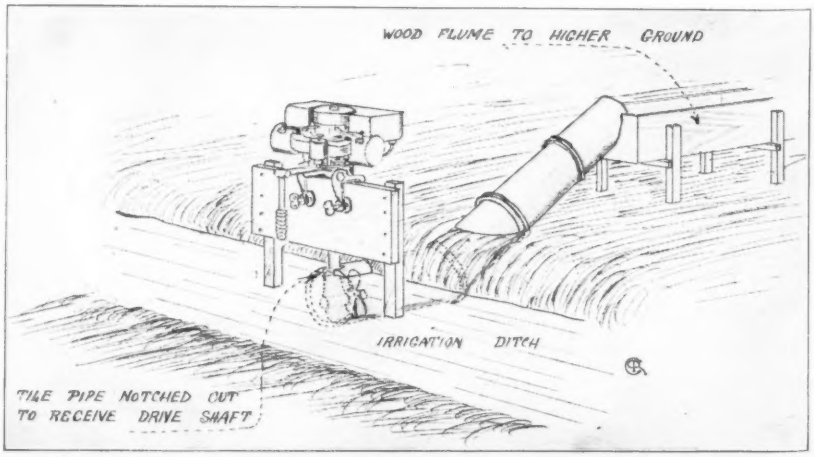
THAT native ingenuity may overcome many obstacles is exemplified in the following letter we received recently from a correspondent together with the accompanying drawing. The letter reads:

"When I visited Uncle Charles last summer he had just acquired some additional land adjoining his own irrigated ranch and found that the general elevation was nearly two feet above his present ditches. To establish a direct gravity flow to the new property would have been a costly job. Since water was available only two days a week he was not anxious to install an expensive pumping plant. In the accompanying sketch I have shown how he used a small motor, outboard type, to accomplish his designs. Running the motor for an hour or so on "water days" was sufficient to fill the ditches on the higher level. Later when the lower part was flooded by spring rains he used the same motor to drain."

Anti-skid Sand Spreader

BY means of an ingenious device perfected by Peter J. Owen, Superintindent of the San Francisco Street Cleaning Department, one of the power driven street sweeping machines has been converted into a sand spreading device. It is used for spreading sand over the streets during the rainy season and as an ordinary street sweeper during the remaining months.

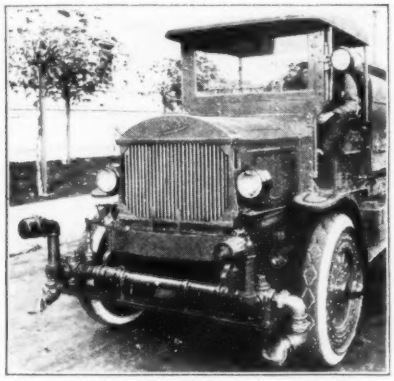
When this equipment is used as a sand spreader, the sand is carried in the box or compartment that ordinarily receives the sweepings. A chain operating from the main drive drives a shaft extending across the front of the sand-carrying box. This shaft operates two bevel gears which are



Uncle Charlie used this motor to lift irrigation water to a higher level

connected to a shaft passing down through a section of the sand box. Attached to the lower end of each shaft is a specially designed cone equipped with vanes. These cones have two speeds, spreading sand to a width of 10 feet on the street at the low speed and to a width of 20 feet at high speed, these speeds being controlled by means of a lever at the driver's seat. The sand is fed from the sand box to the centrifugal cone by means of a gate which is under control of the driver. Sand can be fed into the revolving cones in various quantities so that the sand can be spread over the street to a depth of ½-inch if necessary or it can be so adjusted to spread a thin film.

By the use of this sand-spreading machine, the danger of skidding on streets made greasy by oil from motor cars has been reduced approximately 95 percent. A special effort is made during the dry season to remove grease from the various

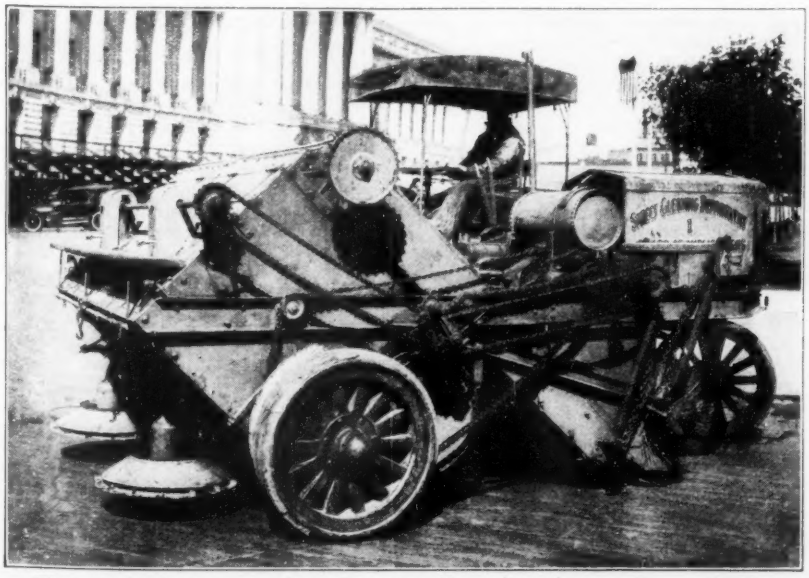


The high pressure street flusher which works in conjunction with the anti-skid sand spreader

streets. The greasy section of the street is first thoroughly flushed by a flushing machine. Then the sanding machine spreads a heavy coating of sand over the greasy area and the flusher is again sent over the section directing a heavy stream of water against the coating of sand. The sand that is picked up by the water cuts the grease from the pavement somewhat in the manner of sand blasting. If the grease has not been completely removed from the pavement by this treatment, a thin film of sand is then spread over the greasy section and permitted to remain, passing motor cars wearing it off by the action of the tires. During the rainy season, sand is spread over greasy sections by the sand spreader, and then later swept up by the same machine. It is claimed that through the use of this system the streets of San Francisco are freer from oil and grease than the streets of almost any other city in the United States.

This sand spreader can sand 52 blocks on Market Street with two yards of sand.

Other cities operating street sweepers could well profit by San Francisco's success in using the sweepers as sand spreaders as the sand-spreading device can be applied to practically any type of sweeper or vehicle able to carry sand.



The anti-skid sand spreader. On rainy days when the streets are slippery with oil and water, sand makes the surface skid-proof. Note cone spreaders

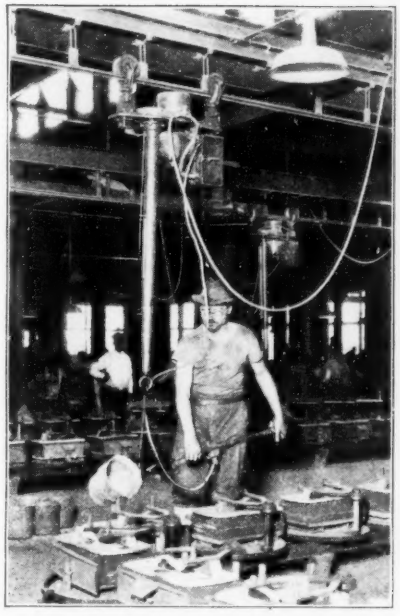
A Mule and a Horse: Twins

THE *News Bulletin* of the Illinois Committee on Public Utility Information states that: "A mare on a Fulton county, Illinois, farm foaled twin colts this spring, one a mule and the other a horse." No details were given.

Electrical Metal-Pouring Service

THE LOUDEN MACHINERY COMPANY, of Fairfield, Iowa, recently announced an electric pouring device for handling the pouring ladles in foundries. This unit consists of an electrically operated carrier which may be suspended from a standard monorail or used with a special pouring crane.

As shown in the accompanying photograph, the electrical equipment of this device is overhead just beneath the monorail track. A telescoping arm hangs downward to hold the ladle while a workman guides it from mold to mold. The rigidity of this lifting arm permits accurate spotting of the ladle over the mold. The motor which lifts or lowers it is controlled by a switch at the workman's finger tips. It is said to be quite quick to respond, and smooth in operation; and will allow the operator to raise the ladle while pouring without interrupting the flow of metal. The device is furnished for either alternating current or direct current operation.



While molders are molding, common labor can pour metal with the aid of this new electrical device

10,000 Miles of Locomotives

JUST 100 years ago—in 1829—the locomotive, *Stourbridge Lion*, underwent a test that was so successful that the question of whether horse traction or steam traction was to be used on railways was settled once and for all. According to *Railroad Data*, American railroads have grown twice as fast in the last 25 years as they did in the preceding 75 years. This statement is attributed to R. H. Aishton, President of the American Railway Association, in an address before the tenth annual convention of the Transportation Division of that organization.

He said further: "And even though rail transportation has existed for 100 years, it is in only the last 25 years that a real science has been made out of it. It took 75 years, or until 1902, to build a total of 258,784 miles of track. In the 25 years following there was built 163,516 miles. In other words, in the last quarter of a century the railroads grew twice as fast as they did in the first 75 years. This is significant, for it shows how you [railroad men] have adjusted yourselves to the change in tempo. This adjustment has been all along the line, in plant facilities, more mechanical improvements, improved methods, but most essential of all in changed mental attitude. All of these changes have contributed in the last six years to the splendid performance in rendering a transportation service that, in so far as its relationship to demands is concerned, might be regarded as nearly 100 percent perfect. There were loaded last year on the American railways 51,576,731 cars of revenue freight, and this stupendous traffic was handled with a minimum of delay and with great efficiency.

"If you took this total of cars that were loaded and put them into a solid train and

(*Please turn to page* 180)

Learning to Use Our Wings

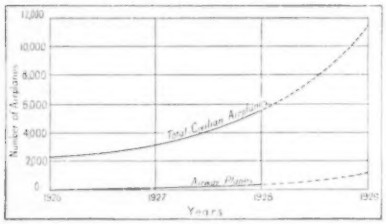
Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

How Many Airplanes In 1936?

IT is always dangerous to prophesy in matters of technical progress. Captain L. M. Woolson, one of the Packard engineers associated with the development of the aircraft Diesels predicts, however, that there will be 1,500,000 airplanes in



Based on this chart, made from figures supplied by the Aeronautics Branch of the Department of Commerce, it is estimated that there will be 1,500,000 planes in use by 1936

service by 1936. This prediction is based on the appended chart of airplanes in service between 1926 and 1929. This indicates a doubling of the number of airplanes in service every year, and the figure of 1,500,000 is arrived at by postulating the same rate of growth.

Cowling to Reduce Drag

THE radial air-cooled engine possesses many advantages over the water-cooled aircraft engine in that it is lighter, and avoids the complication of radiator and piping. It is not so advantageous from the point of view of vision, and it introduces quite a large amount of air resistance or drag.

Aircraft engineers have long sought methods of decreasing the drag of the exposed cylinders by using various forms of cowling. It is impossible to cowl the engine in entirely because it will overheat; cylinders and valve gear must always remain exposed. The N.A.C.A. has recently conducted an exhaustive research into the problem, mounting engines in the front part of the fuselage and measuring the drag in the wind tunnel with various forms of cowling. Some most interesting conclusions have been reached:

1. The drag of an averaged sized cabin fuselage with the nose rounded is tripled by placing an uncowled Wright J-5 engine on the nose (this is the famous Whirlwind which Lindbergh used in his transatlantic flight, and which develops 200 horsepower).

2. The conventional form of cowling in which part of the engine is covered over and the cylinders and valve gear are left exposed reduces the drag by only a negligible amount.

3. But if a cowling such as that shown in our diagram is used, then 60 percent of the drag due to the engine disappears.

The great advantage of this type of cowling which covers the entire engine is that it separates the cooling air from the general flow about the body. The reduction in drag is thus easily explained. At the same time the central opening admits sufficient air to insure proper cooling as both the tunnel and the flight tests have shown.

With this cowling the gain in performance is quite surprising. For example,

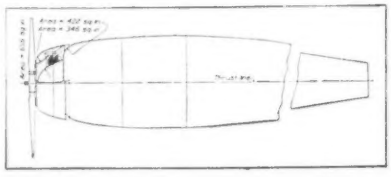


Diagram of N. A. C. A. cowling, showing that it separates the cooling air from the general body flow

a cabin airplane, equipped with a 200 horsepower engine, will have its speed increased from 125 miles per hour to about 133 miles an hour. Since the airplane is already a fairly well-streamlined body such a gain is well worth having.

Airports and Airways

AERONAUTICAL books now appear with such frequency that we could fill the whole of this department with reviews. Still, our readers no doubt like to keep posted on the ever-increasing literature of aviation.

"Civil Airports and Airways" by Archibald Black, (Simmons-Boardman, New York) is an excellent treatise on the subject, compiled with the collaboration of 19 specialists. It is extraordinary how complex the subject is apparently becoming. The clearing of the flying field, grass seeding, oil treatment of soil where no grass is growing, the various materials which may go into the runways, the buildings required, fire protection, lighting—there are innumerable things to be considered. There is no doubt that the text is excellent and as up-to-date as a book can be in this rapidly developing branch of engineering.

We believe that just as much attention should be given to the construction of seaplane bases as to the development of land terminals and are glad to see a chapter devoted to this special subject.

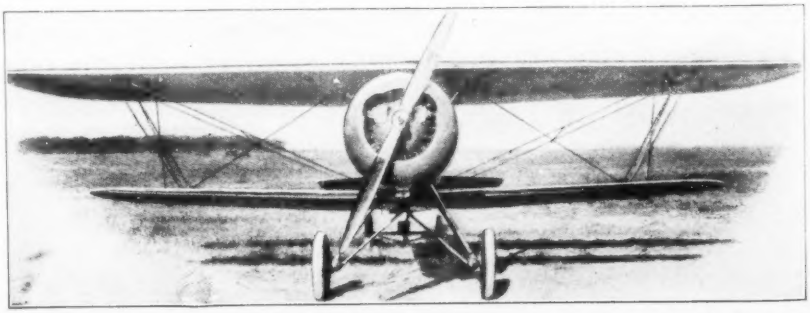
Seaplane base locations should be on some river, small lake, or other body of water which is free from heavy swells. If located on the shore of a sea or a large lake, a small bay or other partly protected body of water is needed.

Seaplanes, even of the best modern design, require greater lengths for take-off than land planes. Hinton, who has written this section of the volume under consideration, recommends an area 3000 to 4000 feet long by 1000 to 2000 feet wide, provided the greater length is so orientated that it lies in the direction of the most frequent take-off. The operating area must be free of high surrounding obstructions. A depth of six feet is considered sufficient to provide draft for any present day seaplane.

To facilitate handling of seaplanes between hangars, shops, and the water an arrangement of aprons, inclined ways, or a marine railway is necessary. The launching ways should not be inclined more than 15 degrees. The seaplane ways may be constructed of wood, with two or more rows of piles driven into the sand, beams set on edge on these and securely spiked to them. Where the largest types of seaplanes are to be handled, it is necessary to install a regular marine railway, using steel rails in place of the single wood track or the launching ways. There is evidently a good deal to the design of a seaplane base, and those seeking further information will certainly read Black's book with profit.

The Fifth National Air Tour

THE National Air Tour has been entirely reorganized, with new management and a new route. The flight this year will start from the Ford Airport, Detroit, on October 5, with the return to Detroit scheduled for 16 days after. The route will be approximately 4400 miles long, and will run from Detroit to Toronto, Ottawa and Montreal,



A front view of the Curtiss AT-5 airplane with new cowling in place. With it, 60 percent of the drag due to the engine disappears, and efficiency increases

in Canada; then to Portland, Maine; Boston, Massachusetts; New York, New York; Philadelphia, Pennsylvania; Baltimore, Maryland; Richmond, Virginia; Charlotte, North Carolina; Greenville, South Carolina; Savannah, Georgia; Jacksonville, Florida; Macon and Atlanta, Georgia; Nashville, Tennessee; Louisville, Kentucky; St. Louis and Kansas City, Missouri; Des Moines, Iowa; St. Paul, Minnesota; Milwaukee, Wisconsin; Moline and Chicago, Illinois; and Kalamazoo, Michigan. Cities where overnight stops are to be made are asked to provide 1000 dollars for gas and oil and hotel accommodations for one pilot and one mechanic from each entry. All competing planes must have the approved type certificate issued by the Department of Commerce.

An extremely important addition to the rules is that no work will be permitted on competing planes during the night stops. All planes will be placed under guard at night to prevent any surreptitious work. The Air Tour thus promises to be a real reliability test.

For marking of the competitors there is a mathematical formula which at first sight appears very mysterious. This is:

$$\frac{\text{Max. D. of C. Useful Load} \times \text{Max. Speed}}{\text{One-half Stick plus Unstick}} \times \frac{50}{\text{Disp.}} = \text{Merit}$$

What this means in English is that the Merit of the competing plane will be obtained by multiplying the maximum useful load permitted by the Department of Commerce certificate by the maximum speed developed in any leg of the route, multiplied by 50, and then divided by the time in seconds required to come to rest after landing, plus half the time required to make a take-off, multiplied by the displacement of the engine in cubic inches.

This rule is logical since that plane will be the best which will have the greatest useful load, the greatest speed, the shortest time to take-off, the shortest time to come to rest, and the smallest engine. Of course all such formulae are arbitrary, but the above formula undoubtedly offers a fair basis of comparison.

A Convertible Craft

OUR photographs show an interesting type of convertible airplane to be manufactured in this country under Belgian license by the Gates Aircraft Corporation.

The conversion from monoplane to biplane or from biplane to monoplane takes only two hours. It is apparently quite simple to remove or add the lower wing and to substitute the appropriate wing trussing.

The two-seater is equipped with a 110 horsepower Renard engine. As a monoplane it has a gross weight of only 1600 pounds, a cruising speed of 112 miles per hour, and a landing speed which is not unreasonable for a skilled pilot.

For primary training, or for use in urban areas where the airport is restricted in size, the addition of the lower wing gives so low a wing loading that a landing speed of 27 miles per hour is claimed, with a high speed of well over 100 miles per hour.

Just as the convertible automobile serves a very useful purpose, it is not impossible that the private or even the commercial operator may find such a convertible airplane of real practical service.

In cold weather it is necessary that airplane motors be treated with utmost care, to avoid trouble. In Canada, snow huts are erected to protect them

Eskimo Motor-Warming Sheds

IN starting an engine in cold weather, quite a number of precautions have to be observed. It may be necessary to adopt some method of heating the air entering the carburetor to prevent the formation of ice at the chokes. The Wright company provides special air-heaters for this purpose. In very cold weather it is sometimes necessary to preheat the oil before starting and it is good practice to drain the oil from the tanks as soon as the day's operations are concluded and before the oil has had time to cool off. If left over night, the oil may become so viscous that it will take a long time to drain off. Some authorities recommend lagging on the external oil pipe lines, the lagging consisting of a layer of asbestos cord, shellacked and wrapped with friction tape to hold it in place.

Priming the engine has to be more energetic in cold weather than under normal temperature. If all these precautions are necessary in our climate, we can imagine what the difficulties are in the bleak Canadian northwest. Canada's flying gold-hunters have had to resort to special shelters of snow around their engines. The accompanying photograph shows native ice masons building a shelter around two Fairchild cabin monoplanes used by these hardy explorers.

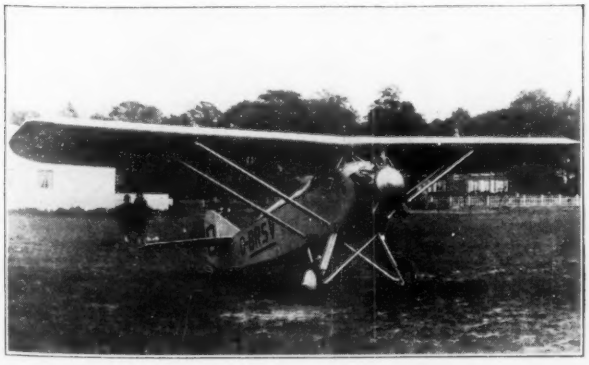
Organization of Private Flying Clubs

THE *Aeronautic Review* announces that after a year's study by a special committee, the N. A. A. has developed a private flying club plan. A grant of 12,000 dollars by the Daniel Guggenheim Fund for the Promotion of Aeronautics will make this plan immediately effective as it will permit the employment of a secretary giving all his time to the project.

Here is the procedure recommended by E. P. Warner, chairman of the Private Flying Club Committee:

1. Get together a congenial group of pilots and would-be pilots, not less than 10 and preferably not more than 30 in number, who can afford among themselves the price of a suitable airplane, with a small reserve for contingencies.

2. Decide what type of plane you prefer to buy. It must be a type having an approved certificate from the Department of Commerce, and will have to have the approval also of the insurance underwriters.



The Gates airplane as a monoplane

A Gates plane fitted as a biplane

3. Decide on the field from which to carry on operations. It is recommended that the operations of private flying clubs should not be based on large metropolitan airports where transport and commercial flying are actively carried on, but on more secluded fields used primarily for instruction and private flying.

4. Make tentative arrangements for hangar accommodations.

5. Decide whether there is to be a professional operation manager or whether the officers of the club will direct operations themselves. If it is expected that a large amount of instruction to student members will be given, there should, in general, be a professional instructor. This has been the practice of the British and Canadian clubs.

6. Write to the Private Flying Club Committee, N. A. A., and apply for a charter. A charter will be granted upon approval of the plans and will be issued together with an insurance policy on the club's operations.

From the financial angle, insurance is an important feature. Apparently if there are 10 members, and a plane worth 5000 dollars is bought, each member will have to pay 125 dollars for insurance, to cover fire, lightning, crash damage, public liability up to 20,000 dollars for one person, et cetera. This item of insurance looks rather large. No doubt it will be reduced as time goes on.

The following are the recommendations for the financial organization of the club:

The total sum to be collected from the charter members of the chapter for the purchase of planes should be equal to the cost of equipment to be bought, plus a 25 percent reserve, plus 200 dollars for general operating expenses. A typical sport plane costing 4000 dollars would thus require an initial fund of 6000 dollars. The membership dues should be 15 dollars for flying members and 25 dollars for non-flying members.

The committee further recommends that there should be a basic charge of 10 dollars per hour for the use of the club's airplanes by flying members on local flights. The rate of 10 dollars per hour is based roughly on the following distribution:

Gas and oil	$ 2.25
Hangar accommodations (based on 300 flying hours per year)	1.35
Mechanical service (inspections and handling machine)	1.00
Engine overhauls and minor repairs	1.00
Minor repairs to airplane not covered by insurance	1.50
Depreciation reserve (to allow for purchase of new plane after 1500 hours)	2.70
Miscellaneous	.20
Total	$10.00

There is no doubt that the plan is the result of exceedingly careful study and that the recommendations are very reliable. Flying clubs have been entirely successful in England; with such wise guidance, they should be equally successful in the United States.

The Ideal Streamline

PROFESSOR B. MELVILL JONES has recently read a paper before the Royal Aeronautical Society on the "Streamline Airplane" which has attracted much attention. He begins his paper with the following striking remarks: "Ever since I first began to study aeronautics I have been annoyed by the vast gap which has existed between the power actually expended on mechanical flight and the power ultimately necessary for flight in a correctly shaped airplane. Every year, during my summer holiday, this annoyance is aggravated by contemplating the effortless flight of the sea birds and the correlated phenomenon of the beauty and grace of their forms."

Roughly speaking there cannot be lift on a wing without drag, because at the ends of the wing the pressure difference between the upper and lower surface of the wing causes an end flow and loss of energy in the form of tip vortices. The lecturer assumes that these tip vortices cannot be eliminated. Neither can the skin friction of the wings be eliminated. No matter how smooth a surface may be there is always bound to be skin friction.

Wind tunnel experiments, however, show that a perfectly streamline body has little more drag than would be accounted for by the skin friction on the surface. Suppose, then, that we can build an airplane which is perfectly streamline. The only resistances to be overcome would be the tip vortex drag and the skin friction.

With such ideally streamlined airplanes, large machines could fly at their present speeds for one third the power, or alternatively travel some 60 miles an hour faster for the same power. Certainly these are results worth attaining.

As design progresses, all external obstructions will disappear. The airplane will be as well streamlined as the bottom of a racing yacht, or the externals of an albatross.

An Unusual Photograph

OUR photograph of the De Haviland 66, is, we believe, a most unusual one. It shows the craft aloft and flying apparently level, with only two of three engines functioning. The right-hand propeller is quite evidently out of commission. There is no doubt that the multi-engined power plant offers a real increase in safety.

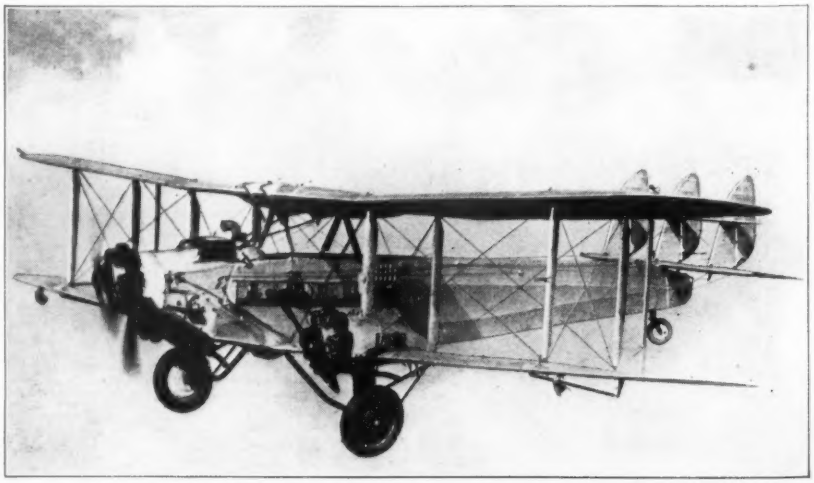
In the development of its air transport system, Great Britain has a great incentive—far flung colonies and dominions which can be connected by air and which provide airways where no competition need be feared. The De Haviland 66 is to be used, for example, on the Cairo-India leg of the Imperial Air Route from London to Australia.

It is interesting to study the De Haviland machine as an example of British practice. With English conservatism, the designer keeps to the biplane type of construction, with a moderately thin wing and a two bay truss on each side of the fuselage. To American observers, such design is none too clean aerodynamically. There are quite a number of projecting struts and wires in the tail groups, for example, with its biplane horizontal surfaces, and three fins and rudders. The whole tail unit is hinged about the front spar of the lower stabilizer for trimming purposes. An innovation which is being used in American practice where a biplane tail is employed, is to trim by movement of one horizontal surface only.

The fuselage is composed of steel tubes, in straight lengths, with mechanical joints and swaged rod bracing. This again is in contrast to American practice, where welding is allowed by Governmental authorities, and all mechanical joints as well as wires and fittings are eliminated, giving greater simplicity, and more permanent alignment of the fuselage.

It is surprising to learn that in a machine as large as this a rubber compression system is still employed. In American practice, the oleo shock absorber system is well nigh universal and provides better shock absorbing qualities and less danger of rebound in faulty landings.

The De Haviland 66 is nevertheless a rugged and entirely serviceable plane, which with its three 450 horsepower Jupiter engines attains a speed of 130 miles per hour. The main fuel tanks are carried in the top center section, the wing being thickened to accomodate the large tanks. Apart from the fuel tanks, each engine is arranged as a separate unit, complete with its own oil tank, oil tank cooler, and instruments. There is accommodation for two pilots seated in the nose and fourteen passengers, although the cabin can be arranged for seven passengers and mail and freight. In the hot countries where the plane flies, particular attention has to be paid to ventilation. The open funnel shown in the photograph is evidently an air-scoop.



A De Haviland 66 flying with one motor stopped. Note ventilator for cabin

The Month in Medical Science

Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

The Danger From X-Ray Films

THE Cleveland disaster due to the burning of X-ray films, with the subsequent development of a highly poisonous gas, has aroused the interest of the world. When the first newspaper reports of the Cleveland catastrophe were issued, the toxic effects were attributed to what were described as heavy brown fumes of bromine gas and to various other toxic gases. To chemists familiar with the decomposition of nitrocellulose, it seemed certain that the brown fumes were those of nitrogen tetroxide.

The inflammable type of film is prepared from nitrocellulose, or nitrated cellulose, as it is frequently called; the substance is one quite familiar to those who have studied explosives and the effects of their gaseous by-products. When the product is subjected to combustion—or "explosion"—there are produced, among other substances, carbon monoxide and nitric oxide (NO). Nitric oxide, even in air, quickly takes on oxygen, forming nitrogen dioxide (NO_2) or its polymer, nitrogen tetroxide (N_2O_4)—the form in which it exists depending on the temperature. All students in first year chemistry recall the preparation of this dark brown substance, dense, but not nearly so heavy as bromine gas.

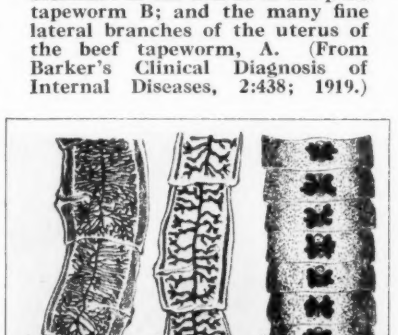
The nitrogen tetroxide, as well as any unoxidized nitric oxide[1], readily reacts on the lungs and with the hemoglobin of the blood. Deaths from inhalation of so-called nitrous fumes have been reported many times. In one case, a carboy of nitric acid to which contaminants had been added accidentally exploded, yielding brown fumes of oxides of nitrogen. Firemen and policement rushed in only to succumb, some almost immediately, others hours later, to the effects of the toxic nitrogen tetroxide. Of a similar nature were the experiences during the World War of some of the observers of the effects after explosions of nitrocellulose.

Films do contain salts of silver, particularly silver bromide, but the amount of bromide present, particlarly in developed films, is relatively small; even so, it seems unlikely that the conditions would be such that the stable silver bromide could be broken up sufficiently to yield bromine gas in anywhere near the toxic quantities reported. Films are also produced by various combinations of organic substances; synthetic camphor is used in making some types. It will be recalled that the reports of the Cleveland disaster emphasized the fact that the odor of camphor was present during the terrible calamity.

To sum up, it is apparent that in the complexity of fumes which may be given off during ignition of a large collection of both old and new films there is a possibility of the presence of the toxic carbon monoxide and nitrogen tetroxide as well as of other toxic or irritating substances. It appears unlikely that bromine could develop in amounts sufficient to be of importance.

There are two general classifications of films—inflammable and non-inflammable. The non-inflammable—a "safety" film—does not contain the nitrated group; hence it is slow burning and the hazard of combustion is minimized. The chief disadvantages of the non-inflammable over the inflammable film are stated to be the increased cost of the former and the tendency to roll and curl. The fire hazard of storing

Above: **Differential characteristics of the heads of the three principal types of tapeworm infesting man. (From French's Index of Differential Diagnosis, ed. 3, 1920, p. 519.)**
Below: **Differential characteristics of the adult segments. Note the rosette shaped uterus of the fish tapeworm C; the few, coarse, branches in the uterus of the pork tapeworm B; and the many fine lateral branches of the uterus of the beef tapeworm, A. (From Barker's Clinical Diagnosis of Internal Diseases, 2:438; 1919.)**



Roentgen-ray films, particularly the inflammable type, has been recognized for some time. In fact, all hospitals provide special rooms and special apparatus for storing, although the conditions vary from hazardous to safe. There is need for constant vigilance.

Fish Tapeworm Infestation

PREVIOUS to 1906, infestation of persons in the United States with the fish tapeworm was exceedingly rare. About that time, Warthin of the University of Michigan pointed out that the waters of the Great Lakes and of the smaller lakes in the vicinity were being contaminated with the fish tapeworm and that an increasing number of cases might be expected among Americans in the vicinity. Innumerable cases have now been collected by many investigators. It is interesting to know that the early cases were found among people who had come from Finland and other Scandinavian countries and that one out of every five persons in Finland is a subject of the disease.

Dr. Moses Barron has recently called attention to numerous cases seen in Minnesota. Whereas the cases seen from 1911 to 1919 were primarily among Finns, Swedes, and Americans, the majority of cases seen since that date have been among Jewish people, primarily women. Doctor Barron's explanation is that the infestation of the women is due to their tendency to taste the raw fish while they are preparing the dish commonly called "gefüllte fish." This dish consists of minced raw fish carefully seasoned before boiling. In order to make sure of the proper seasoning, the housewife tastes the minced raw fish repeatedly before it is finally cooked. During this tasting process she becomes infested with the eggs of the tapeworm.

When the condition occurs in children, it is apparently due to the fact that the child comes into the kitchen and is given a taste of the raw fish.

The prevention of the condition is clear. It involves cleaning up the water in which the fish are infested and urging thorough cooking of fish before eating.

Constitution and Reproduction

THE great trend of modern medicine is toward a study of the individual human being as a whole, taking into account heredity, constitution, and environment, rather than the diseased state of any individual organ. One of the most important aspects of this investigation of mankind has to do with the power of reproduction.

In a significant consideration, Dr. Samuel R. Meaker of the Boston University School of Medicine found that failure to reproduce was in most instances due to many causes rather than to a single cause; that in the majority of cases constitutional factors depressing the fertility of one or both partners were operative. It is significant that the incidence of constitutional faults is greater in the male than in the female. Hence a study of the failure to reproduce involves not only a careful investigation of the physical capacity of the sex organs, but also a very complete study of the constitutional states of both the husband and wife.

In many instances bad functions of the glands, and insufficient diet, particularly with relation to the vitamins may be found to be responsible in some part for the failure to reproduce.

[1] The oxides of nitrogen discussed here do not include nitrous oxide (N_2O), which is well known to the medical profession as an anesthetic gas.

An X-ray photograph of the foot bones of an infant one week old

Shoes for the Baby

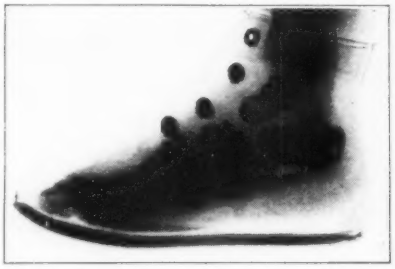
A SUBJECT of perennial interest to mothers and to orthopedic surgeons is the selection of the first shoes for the infant and the gradual change of the shoes as the foot develops. During the last great war, innumerable men were rejected for service because of flat-feet. Nowadays it is recognized that flat-feet not infrequently function fairly satisfactorily. However, there is much advantage in having good feet capable of marching 15 miles a day without strain and feet that present what is recognized as a suitable appearance.

A "paper bag" shoe such as this one should be worn by an infant who is just starting to learn to walk

The X ray shows clearly how the parts of the foot in a properly fitted shoe are free and uncramped

In a consideration of the subject, Dr. John D. Adams points out that far too often shoes are selected from the point of view of vanity rather than of service. He insists that the first shoes of the infant should be like a paper bag with just enough shape to make it possible to call it a shoe. The material should be soft white kid with a flexible unresisting sole and with a draw string of tape at the top.

Between the ages of two and five, the shoes must be somewhat more substantial. At this age the shoe should be sufficiently broad to allow the toes to assume a natural, uncompressed weight-bearing position, at least one half inch longer than the weight-bearing foot. It should have a well shaped heel, sufficient depth from the vamp in the middle of the foot to the middle of the sole, and a broad flexible sole with a straight outside.



Effect of shoes that are too short, showing the beginning of flexion deformity and future trouble

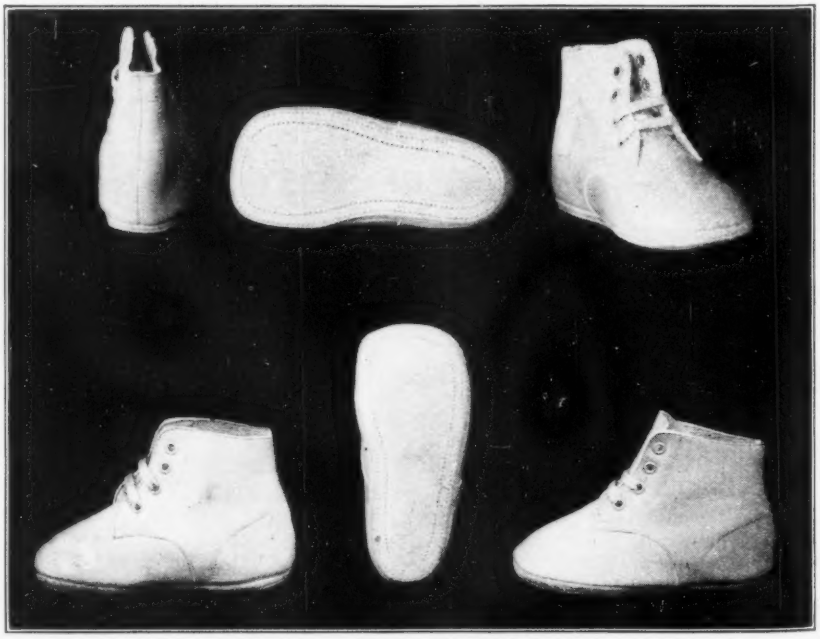
Up to the age of three and one half years, the shoes should not have a heel any thicker than the sole; and from three and one half to five years, the heel should be twice as thick as the sole. In the accompanying illustrations the important points here emphasized are well brought out.

An interesting relic of 100 years ago. A child's shoe from that time

Two different types of children's shoes made with moccasin toes

Backache in Golf and in Polo

IN a brief consideration of backache occurring particularly to players of golf and polo, Dr. Horace Gray points out that this results not so much from play as from excessive and wrong golf practice. In three cases which he investigated, the ages ranged from 35 to 45 years, the side involved being the left, all of the patients being right-handed. The cause was limited definitely to the use of the irons, particularly the mashie and the niblick, in which there is a brisk snappy twist of the trunk as the ball is struck. When this stroke was repeated frequently, the result was a pain in the back. Dr. Gray insists that people subject to low back strain should be warned particularly against too much practice with the short distance clubs.



Several views of the ideal child's shoe

From dance hall floors to railway coach ceilings ..this grainless wood board

Beauty, such as paneled ceilings need, is usually required to sell a product. Durability, that a floor must have, is necessary to keep it sold. Manufacturers who adopt Masonite Presdwood find that it gives their products both durability and beauty. Samples for testing will be gladly supplied.

FOR DANCE HALL FLOORS

In a Denver dancing academy the tap-tap-a-tap of metal tipped clogs resounds from a floor of Masonite Presdwood. At Pullman, Illinois, ceilings of Presdwood are applied to railway coaches. And in scores of widely varying industries, hundreds of products are being made better and at lower cost because of this grainless wood.

Many of these Presdwood products require the strength and durability that are indicated in the service rendered at Denver. Used eight hours a day at the Fred Merritt School of Tap Dancing, the Presdwood floor showed no signs of wear, even after weeks and weeks of usage. Other Presdwood products may require smoothness and ease of finishing — there, again, Presdwood is ideal, as evidenced by its use for paneling . . . not only in ceilings of railway coaches but in fine homes and buildings as well.

Is easily cut

Beauty and lasting qualities are but a part of the advantages of Masonite Presdwood. It is moisture resisting and almost immune from warping, shrinking and buckling. It is extremely easy to work with. It can be sawed, punched, planed, milled or sanded. It is liked by shop foremen, experienced with materials of all kinds, and is just as welcome in homes where handy men put up shelving or build a radio cabinet. Wherever it is used it never harms fine tools, for it contains no artificial binder.

FOR RAILWAY COACH CEILING

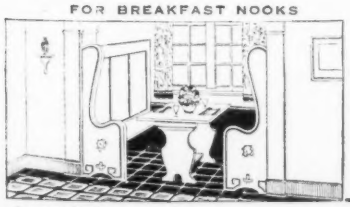
Has wide range of uses

The uses of Presdwood are many and varied. They range from bedroom screens to toys, from motor truck bodies to hydroplane hulls, from bread boxes to loud speaker tension boards, from out-door signs to kitchen cabinets, from office partitions to billiard tables, from clothes hampers to breakfast nooks.

Fully eighty of Presdwood's many uses, in industry and the home, are listed in the Presdwood booklet which is gladly sent to those who appreciate the beauties of fine materials or who wish to effect manufacturing economies with this workable grainless wood.

MASONITE CORPORATION
Dept. 740, 111 W. Washington Street
Chicago, Illinois

FOR BREAKFAST NOOKS



Masonite PRESDWOOD

Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

FOR PANELING

Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

What Is Petroleum?

WHAT is the chemical composition of petroleum? The answer is similar to that for the question "how long is a string?" Chemists say that petroleum is a complex mixture of various hydrocarbons, and readily identify a number of these compounds, composed of different combinations of carbon and hydrogen. In the commercial distillation of petroleum, the oil is broken up into five fractions known as naphtha, kerosene, gas oil, wax distillate, and bottoms. Each of these fractions may be further subdivided by additional refining, a great variety of well known and indispensable products resulting.

An examination, however, of the literature on the composition of petroleum discloses the reported existence of a large number of different hydrocarbons to which formulae and values of physical properties have been assigned. A study of the evidence presented in identification of these "compounds," however, impresses one chiefly because of its inadequacy. "In fact," says Edward W. Washburn, of the United States Bureau of Standards, "with the exception of some of the lower boiling constituents, most of the compounds whose existence has been reported must be classed as purely fictitious in the light of the evidence at present available."

The United States Bureau of Standards is now conducting experiments to determine just how the atoms of hydrogen and carbon are hooked together in the various fractions of petroleum. The task presents many difficulties, for the atoms are prone to rearrange themselves on slight provocation so that the products driven off by the usual distillation method may have been present originally or may have been formed during the distillation—one never knows. Accordingly, it has been necessary to develop the special still shown in the illustration. The asbestos-covered pot in the center, surmounted by the tall rectifying column, contains the petroleum fraction to be tested. The temperature of the oil in this still pot is kept constant and low enough to avoid cracking, while distillation is compelled to proceed by passing a fine stream of hot carbon dioxide bubbles through the oil. The distillates are conducted through the rectifying column and thence through a series of condensers kept at progressively lower temperatures down to -80 degrees, Centigrade.

With the aid of this apparatus the Bureau hopes to be able to answer with scientific precision the question: "What is petroleum?"

Sulfur in Air Attacks Drying "Wash"

IF you would have your cotton goods last longer, do not leave the wash hanging on the line over night. This is not a warning against light-fingered hoboes who might take a fancy to a shirt hanging "all by itself in the moonlight" but against an odd nuisance that is known to laundry men as "winter damage." In tests now being conducted by J. J. Wilkie of the United States Bureau of Standards it was found that during typical "winter damage" weather, overcast days in the winter time, wet towels took up sulfur dioxide when exposed in ordinary city air in Washington, D. C., and became acid in reaction. This did not occur on clear, dry days, but often did occur when the towels were hung out overnight.

The fact that the damage is found only in wet wash, which is returned to the customer to be dried and ironed, led to a comparison of the effect of home finishing with laundry finishing. It was found that the breaking strength of towels which were repeatedly washed, dried outdoors, and ironed by hand decreased faster than the breaking strength of similar towels washed at the same time and finished in the laundry.

This deterioration may be attributable in part, at least, to atmospheric sulfur dioxide. This was shown by exposing damp towels to air containing one part per million of sulfur dioxide, ironing, moistening the towels and repeating the treatment. Towels processed in this way decreased in strength at about the same rate as towels which were washed in the laundry, hung outdoors, and dried. Towels containing small amounts of iron deteriorated much faster than towels containing no iron. Very small amounts of chlorates, or of soap mixed with sodium hypochlorite, such as might remain in the goods from the laundry, also promoted deterioration of towels when exposed to air containing sulfur dioxide. Sulfur dioxide in cloth is readily oxidized to sulfuric acid, which is injurious, especially when heated, as when the cloth is ironed.

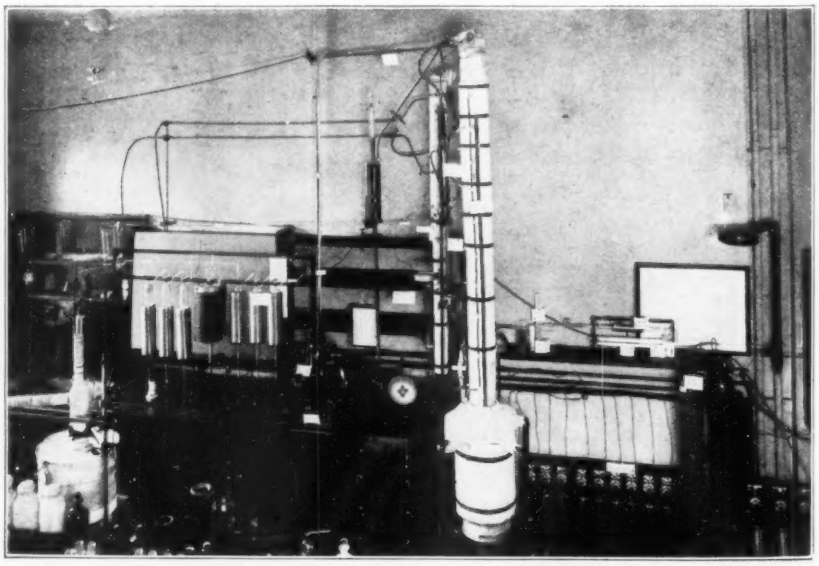
Chemical Belt Dressing Eliminates Static

DISCHARGES of static electricity, built up by moving belts, occasionally result in disaster when the discharge takes place in the presence of inflammable vapors or gas. P. W. Edwards and J. O. Reed, of the Bureau of Chemistry and Soils, U. S. Department of Agriculture, have recently developed non-static belt dressings which eliminate this threat of static electricity.

The requirements for a non-static belt dressing are as follows: (1) It must have sufficient electrical conductivity to remove or neutralize static electrical charges as rapidly as they are formed; (2) it should be of such a nature that it can be easily applied; (3) it should resist wear; (4) it should not decrease the coefficient of friction of the belt on the pulley; and (5) it should not be injurious to the belt.

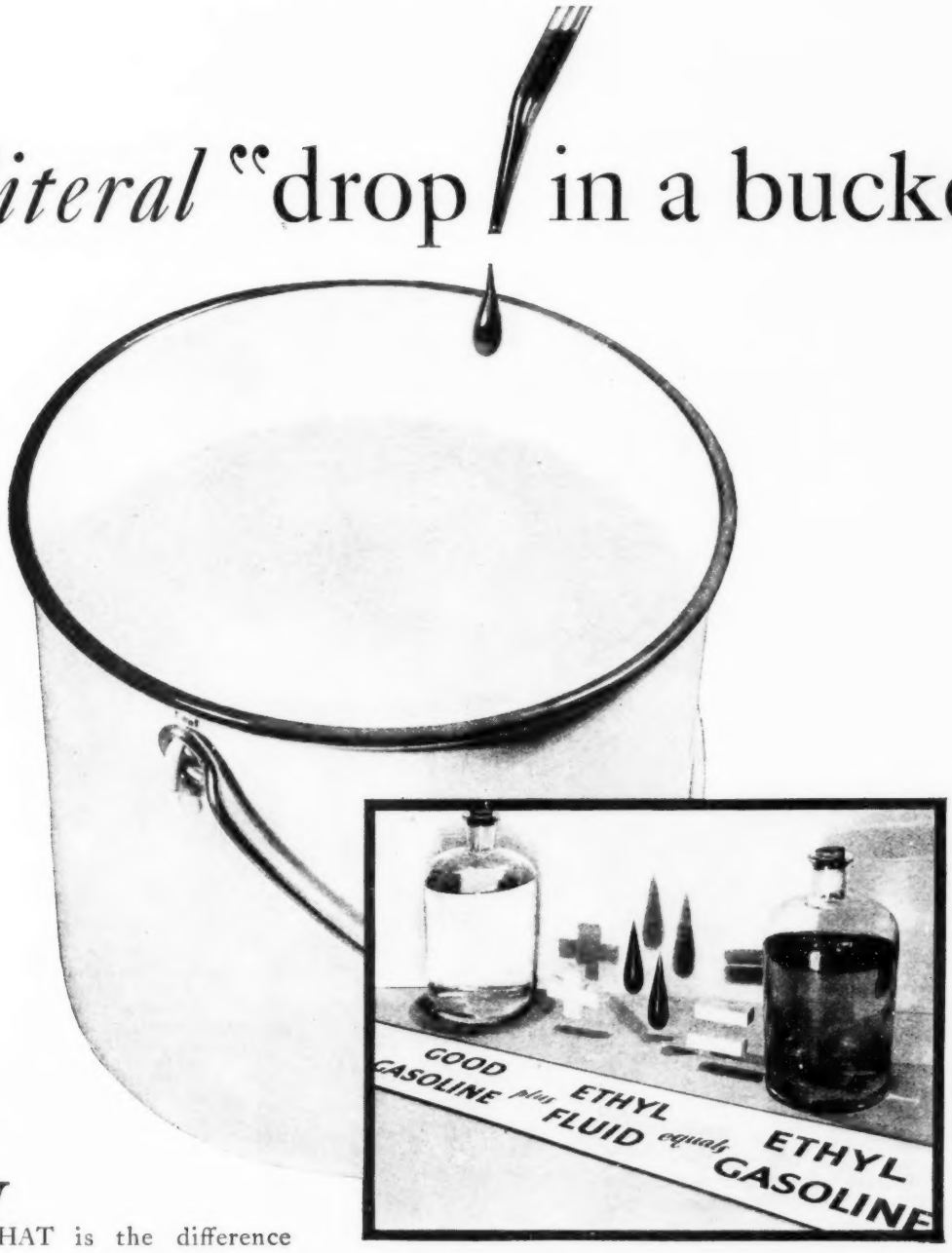
A good rubber belt dressing can be prepared by mixing 18 parts of lamp black with 82 parts of good spar varnish. A smaller quantity of lamp black may prevent most of the cracking which develops after the above dressing is used for several months. The dressing must be allowed to dry on the belt before the belt is used. A non-inflammable thinner for the varnish can be prepared by mixing equal volumes of carbon tetrachloride and varnish makers' and painters' naphtha.

A non-static leather belt dressing which has considerable merit consists of 100 cubic centimeters of liquid fish glue, 80 cubic centimeters of glycerine, 100 cubic centimeters of sulfonated castor oil, 170 cubic centimeters of water, 82 grams of lamp black, and 20 cubic centimeters of



An improved rectifying still at the Bureau of Standards laboratories in Washington for determining the exact composition of petroleum distillates. Carbon dioxide from the tanks at the right is bubbled through the oil to promote distillation. Between the tanks and the asbestos-covered still, to which the rectifying column is attached, is a series of rheostats for controlling the 20 electric plates used to study the composition at various heats

A *literal* "drop in a bucket"



WHAT is the difference between any good gasoline and Ethyl Gasoline? In one sense very little. Ethyl *is* good gasoline with just a little Ethyl fluid—less than a teaspoonful to a gallon—mixed with it.

The great difference between the two lies in the performance they get out of an automobile engine. So effective is that small amount of Ethyl fluid that it eliminates the "knock" from your engine and puts to work that power which is wasted with ordinary gasoline.

Ethyl fluid was developed by automotive science to eliminate the "knock" and power loss which occur when ordinary gasoline is compressed beyond a certain point.

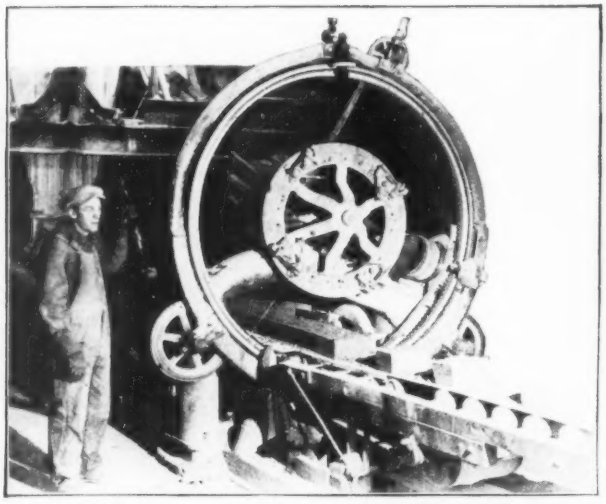
A high compression engine needs fuel of Ethyl's anti-knock quality if it is to do its best. And Ethyl gets out of engines of average compression additional power impossible to obtain with ordinary gasoline.

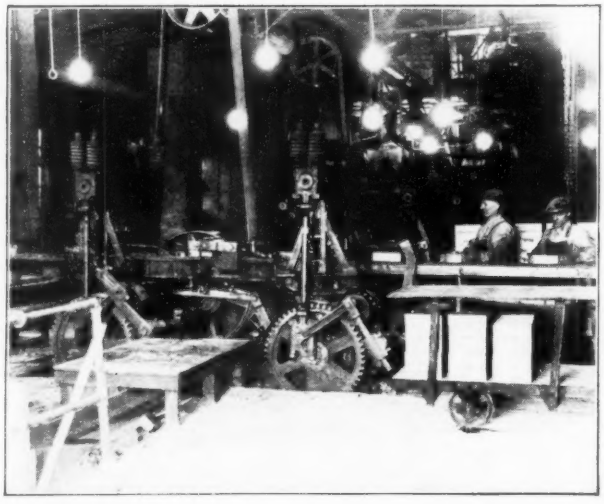
Start riding with Ethyl today. See the difference it makes.

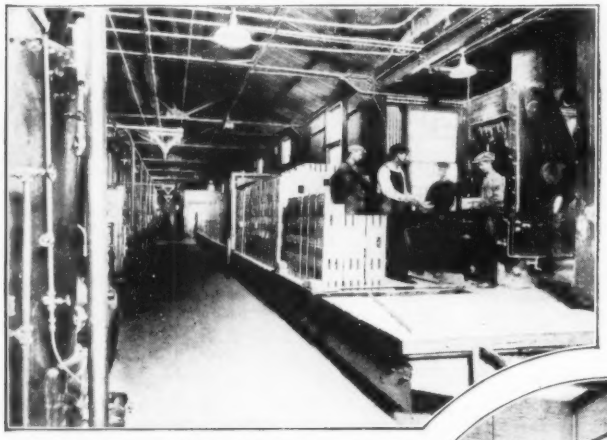
Ethyl Gasoline Corporation, 25 Broadway, New York City; 56 Church Street, Toronto, Can.; 36 Queen Anne's Gate, London, England.

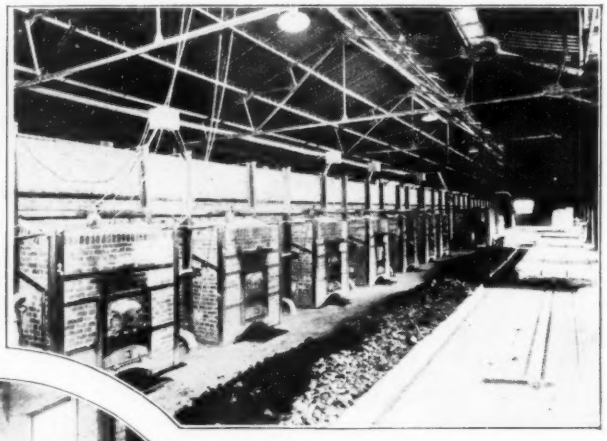
ETHYL GASOLINE

© E. G. C. 1929

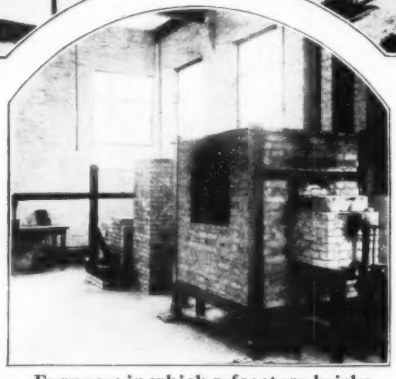








At the top of the illustration is shown a machine for cutting a strip of fireclay brick into small blocks. *Below:* After sizing, the bricks are placed on trucks which roll into the drying kilns, warmed by means of waste heat from the kilns in which the refractory bricks are "burned" scientifically



Furnaces in which refractory bricks are tested to determine their ability to support the usual load

***Top:* After the bricks have been cut into blocks they are transported by an automatic conveyor to this patented sizing machine, which insures refractories of uniform size and shape. *Below:* Kilns in a modern plant, where refractory bricks are fired with carefully controlled temperature and humidity**

two percent ammonium hydroxide. These proportions may not be the best for all conditions. In some cases better results will probably be obtained by increasing the quantities of fish glue and glycerine. It may be easily applied with a brush while the belt is moving. It is not necessary for this dressing to dry before running the belt. If the belt has not been properly maintained this dressing will cause it to stretch.

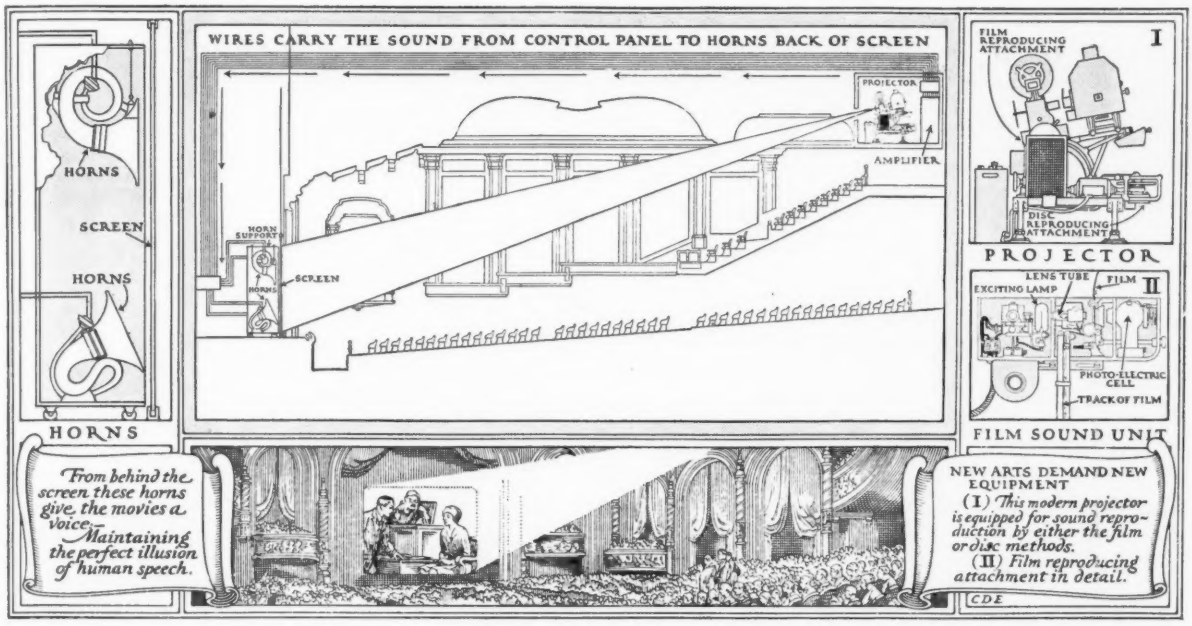
Chemistry Contributes to Better Bricks

THE ancient proverb to the effect that you can't make bricks without straw has been succeeded by modern recognition of the fact that you can't make good bricks without chemistry and scientific precision. If you require bricks merely to throw at somebody you need not be fussy about the specifications, but if you happen to be building a boiler setting or a furnace wall you will do well to select a refractory brick which is the product of careful scientific manufacture and technical control.

Recent innovations in the manufacture of refractory brick are described by L. J. Trostel, Chief Chemist of General Refractories Company in *Chemical and Metallurgical Engineering*. Instead of being limited to fireclay brick, says Mr. Trostel, the user of refractories now has the additional choice of magnesite, dolomite, chromite, silica, diaspore, mullite, kaolin, silicon carbide, zircon, and corundum. It is further significant that the actual tonnage of refractories now produced in the United States is not greatly in excess of what it was in 1920—in spite of the rapid growth of the consuming industries and increasingly severe service conditions. The answer, of course, is that the quality of refractories has been so improved that they will withstand the higher temperatures and faster production schedules of modern industry.

Several advances in the processing of refractories have distinctly improved the quality of the product. Originally, refractories were hand-molded, dried, and burned under rule-of-thumb control. Then, as in other branches of the ceramic art, successful production was entirely dependent upon the personal skill and judgment of a few men in the plant. With the introduction of other types of refractories and methods of manufacture, there came a new type of thinking that helped to change the industry from a craft and place it on a scientific basis.

The trend continues, for research now in progress has revealed further possibilities of improvement in the drying and burning of silica, magnesite, and chrome brick, of casting refractories of definite composition and structure from the fluid melt of an electric furnace, and finally, of scientifically building up a brick of accurately sized particles in order to furnish a product of maximum denstity and minimum voids. New materials of high refractoriness, which have been hitherto unused because they lacked volume stability at high temperature and under load, have been successfully modified to meet industrial conditions. Other desirable effects have been attained by burning in atmospheres of definite composition.



WHAT MAKES THE PICTURE TALK?

Your enjoyment of a Sound Picture depends largely on the quality of apparatus used. It pays to go to theatres equipped by the makers of your telephone—the Western Electric Company

The sensitive Sound Picture microphone (C), designed for studio recording. A development of the broadcasting microphone (B) and the telephone transmitter (A), indicating how "Sound Pictures came out of the telephone."

WHEN you go to hear a Sound Picture you wish to be certain that the voices will be clear and natural; that the musical accompaniment and the sound effects coming from the screen will be thoroughly pleasing.

Near you is probably at least one theatre which assures just that, because it is equipped with the Western Electric Sound System. This apparatus, made by the makers of your telephone, is installed and inspected by engineers trained in this new art.

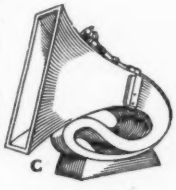
The reliable quality of this Sound System has been recognized by over 2,000 theatre exhibitors — exhibitors who have a habit of considering their patrons' satisfaction and who therefore believe that it is worth a little extra investment to secure equipment of proved results.

In selecting Western Electric these exhibitors knew that the correct transmission and reproduction of sound is an extremely difficult problem, as is evidenced by the wide differences in quality between various radios and phonographs. They knew that it was Western Electric's experience with this very problem which, after years of unsuccessful effort by others, finally made Sound Pictures possible.

This same organization which brought the telephone to its present excellence will likewise constantly seek to improve Sound Picture apparatus still further.

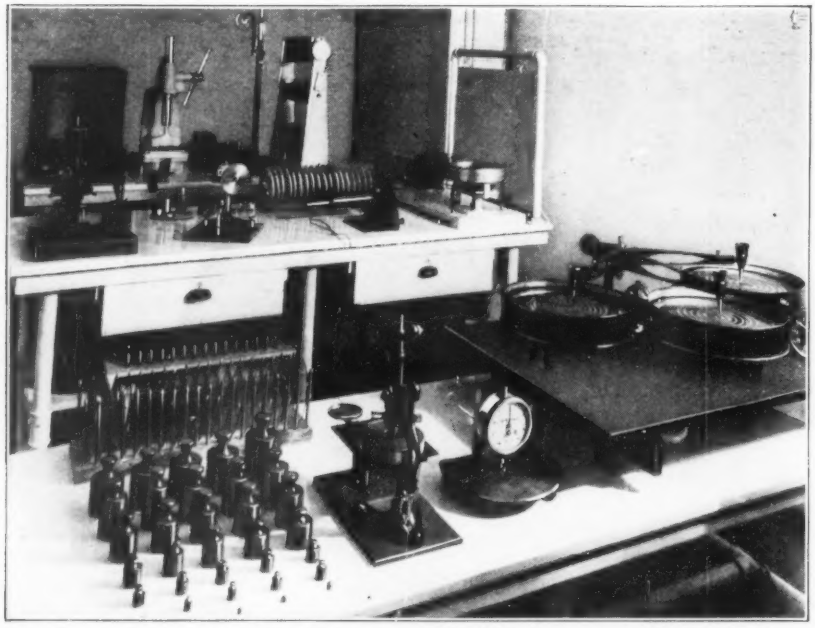
To Theatre Exhibitors

People know good Sound reproduction when they hear it. They are quick to appreciate the high quality assured by Western Electric equipment. If your theatre is thus equipped you will render a service by displaying that fact in your advertising and in lobby and outside signs. For additional information address Electrical Research Products, Inc., 50 Church Street, New York.



The loud-speaking horn (C), a marked improvement for Sound Picture purposes over the cone loudspeaker (B). It is a direct descendant of the familiar telephone receiver (A), and is made with the same care.

Western Electric
THE VOICE OF ACTION
SOUND SYSTEM



Paint and varnish testing laboratory at the Experimental Station of E. I. du Pont de Nemours and Company at Wilmington, Delaware. The drying-time meter, shown at the extreme right, has three cones depositing spiral trails of sand on drying films of paint. Other apparatus shown includes hardness testers, a film thickness gage, surface tension apparatus, print tester, an instrument for measuring gloss and a device for making paint films

Unique Instruments Test Properties of Paint

PSYCHOLOGISTS may be able to explain why the familiar sign "Wet Paint" creates an irresistible impulse in passers-by to touch it with doubting finger-tips. The paint chemist, however, is not satisfied to judge degree of dryness by such a simple procedure, and has devised ingenious instruments for determining with scientific accuracy just how long it takes a paint film to pass through progressive stages of dryness. One of these drying time meters is shown in an accompanying illustration. It consists of a rotating disk, like a glass phonograph record, on which is laid a coat of fresh paint. A small cone, suspended over the disk and moved slowly horizontally while the disk rotates, drips a special trail of fine sand on the paint film. After the paint is dry, the disk is tapped sharply on the back, the loose sand flys off and reveals the exact point at which the paint became too dry to make the grains adhere.

Drying time is only one of the properties of paint that must be controlled and studied in the chemists' quest for better protective coverings. Hardness of the dry film is equally important, and apparatus for testing this property is also shown in the photograph, taken in the Experimental Station of E. I. du Pont de Nemours and Company, Wilmington, Delaware. One of the first investigations made with a quantitative hardness tester revealed the fact that two out of four products tested actually became softer, rather than harder, as time went on, according to D. V. Gregory, writing in the *du Pont Magazine*. The weather reports for this period showed that humidity had increased. In other words, the effect on the film of increasing the humidity was greater than the rate of drying. Not until the humidity dropped again did these products harden.

Later results under carefully controlled atmospheric conditions showed increasing hardness of these same products with time. Other tests showed that in some cases raising the temperature 20 degrees, Fahrenheit, caused the films to soften to one tenth of their former value. In a series of products tested, none of them was harder at elevated temperatures. In the case of humidity, the effect is not so great as with temperature, but a 25 percent increase in relative humidity decreased the hardness to one fifth the original value. Relative humidity may be defined as the percentage of moisture in the air at any one time, compared to the amount of moisture in saturated air at the same temperature.

Temperature and humidity also affect the drying time, although not so much as they do hardness. For example, dropping the temperature from 77 degrees to 42 degrees, Fahrenheit, and raising the relative humidity 35 percent, in a number of cases caused a slowing up of drying to one third, and in a few instances to one fifth and one tenth the former rate.

These same factors also affect the elongation and tensile strength of protective coating films. For example, the elongation of a film in a saturated atmosphere—100 percent relative humidity—may be as much as 60 percent greater than is the case with an absolutely dry film. Under these conditions the tensile strength may decrease to one tenth the former value. A 10-degree increase of temperature may raise the elongation to as much as 10 percent and lower the tensile strength 25 percent.

It is obvious that humidity and temperature are important factors in the behavior of paint films. In order to control these variables, du Pont chemists carry on such investigations in a room where both temperature and humidity are kept exactly the same all through the year by automatic air conditioning equipment.

'Stickum" For Stamps

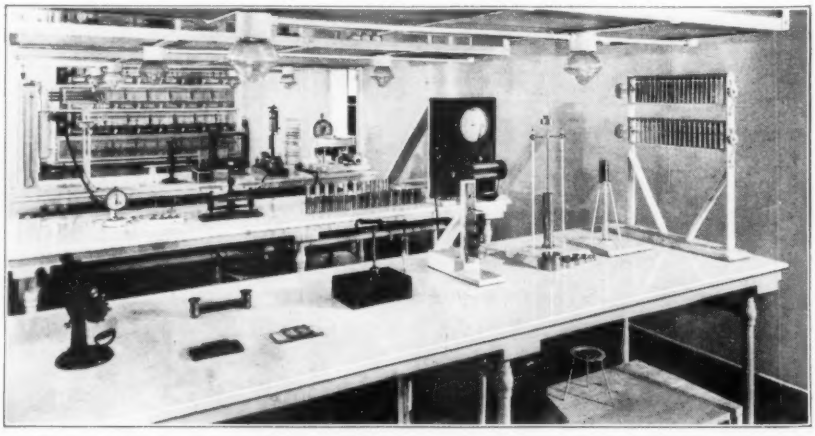
VICTOR G. BLOEDE, president of a Baltimore company which bears his name, is the man who makes the postage stamp gum for the government. His is no ordinary business, and it has a fascination for the layman. The finished product must be wholesome enough for a baby to eat, strong enough to hold up against wear and weather, and thin to the vanishing point.

The base is tapioca starch from Java. Roasted, powdered, and treated with chemicals, this becomes a fine cream-colored powder, and in this form it is shipped to Washington by the carload. Something like 1,000,000 pounds of this cream-colored powder is used by the government every year.

Scientific Dish Washing

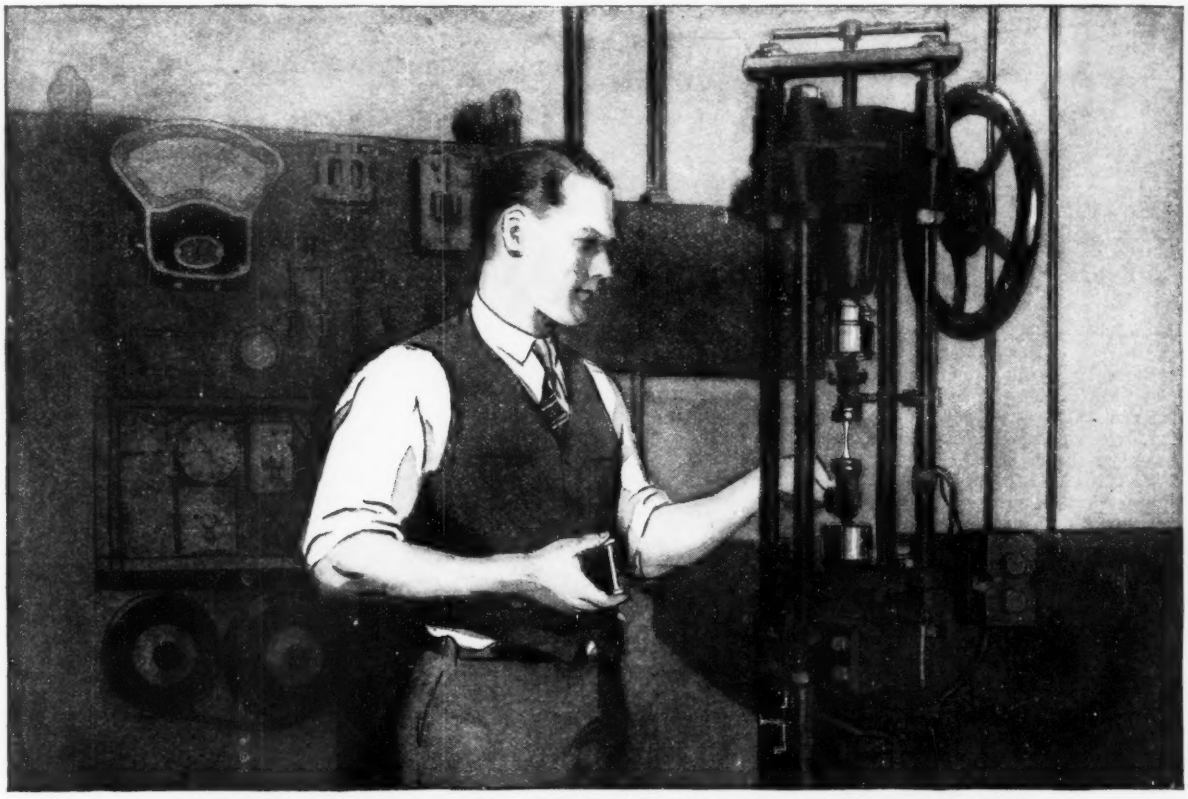
IN restaurants, cafeterias and hotels, washing the dishes is just as drudging a job as at home—unless the chemist and dishwashing machine man are called in to help. The commonest way of washing dishes in these establishments is to use a big pan full of hot water with some heavy

(*Please turn to page* 183)



Temperature room of the du Pont company's Central Technical Laboratory in Philadelphia. The temperature and humidity in this room are controlled and regulated to eliminate almost all variations. This is done with automatic air conditioning equipment, refuting Mark Twain's comment that "Everybody talks about the weather, but nobody ever does anything about it"

WHAT WESTINGHOUSE IS DOING IN RESEARCH



WESTINGHOUSE ENGINEERS HAVE DEVELOPED SPECIAL MACHINES IN WHICH THEY MEASURE THE DYNAMIC STRENGTH OF MATERIALS UNDER ACTUAL SERVICE CONDITIONS

Feeling the muscles of metals at work

"Feel my muscle," challenges the proud urchin, "I can lift fifty pounds." But set that same youngster at work and his lifting ability quickly dwindles.

So it is with metals. A test bar of steel may register a strength of fifty thousand pounds in a common laboratory testing device. Yet a shaft of the same material in a whirling, vibrating machine might fail if loaded half as much.

Westinghouse engineers must know exactly how strong metals are when at work. To find out they have developed testing machines that whirl shafts and jiggle them while they measure their strength within a fraction of a pound.

They have built machines also that test the strength of metals under the corrosive action of wet steam, and that measure the amount of permanent deformation which may result after long service at high temperatures.

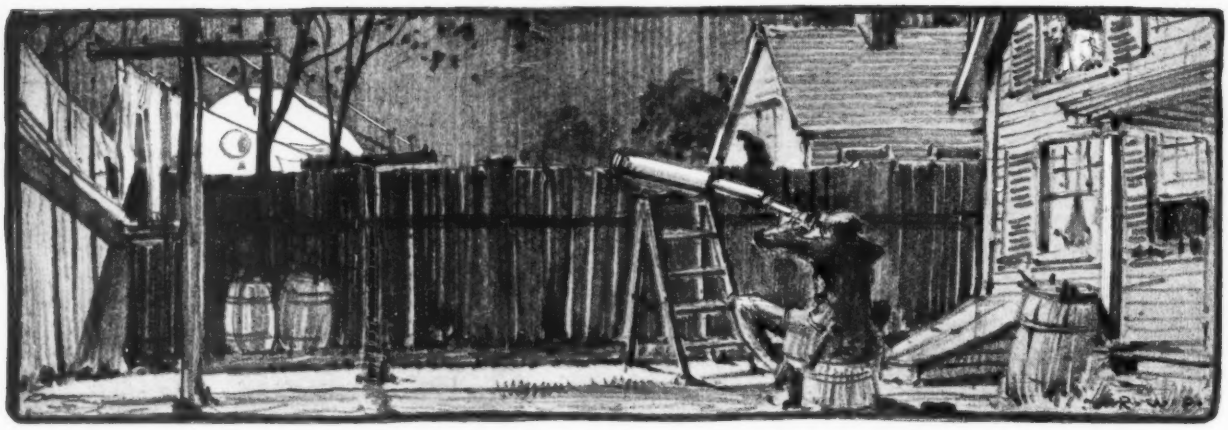
With the knowledge gained from these dynamic testing machines they have been able to cut down the bulk, the weight and the vibration of electrical machinery without sacrificing reliability.

Westinghouse, through untiring research into every factor of principle and design, continually leads the way to new economies and improvements in electrical equipment.

The Sign of a Westinghouse Dealer

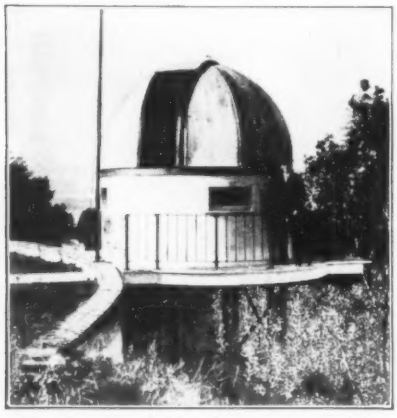
Westinghouse Electrification Appliances Apparatus Wiring

Westinghouse



The Amateur Astronomer

SOME pretty swank looking telescopes have been turned out by some of the readers who have caught the germ of the amateur telescope making disease. Looking over the dozen or more descriptions which we have on file for future publication, this impression is greatly strengthened. One of the most trim jobs we have seen is that of Mr. H. B. Ross of the Ross Carrier Company at Benton Harbor, Michigan. Mr. Ross' letterhead indicates that his



Mr. Ross and his observatory, with Lake Michigan visible just at the left, through the trees

company manufactures motor driven carriers, those odd-looking but very practical gasoline or electric trucks which, with wheels mounted on tall legs, run up to a pile of lumber, straddle it, pick it up bodily and run off with the whole pile without a stick being separately handled.

"I enclose," writes Mr. Ross, "some prints of a 12-inch reflecting telescope I made with the help of your wonderful book 'Amateur Telescope Making.' About a year ago I picked up a volume of Flammarion's 'Popular Astronomy,' and after reading it determined to have a telescope and purchased a 4½ inch Zeiss instrument with a triple lens objective. I then subscribed to the SCIENTIFIC AMERICAN in order to get the monthly star maps. Thus I discovered you had a department devoted to this delightful hobby and got a copy of 'Amateur Telescope Making' at once. It proved to be a valuable treatise.

"I made an 8-inch mirror first, to get some experience, and then tackled the 12-inch. It is remarkable how everything behaved just as the book explained, throughout the successive stages of grinding, polishing, and figuring the concave mirror. For grinding I rigged up a machine driven by a washing machine motor. This had a variable stroke, either straight or elliptical, and an adjustable feed for rotating the glass disks in opposite directions. It worked very well. [For the information of new readers, all the work is generally performed by hand.—*Editor.*] However, I did most of the polishing by hand. A true paraboloid showed up before the polishing was half completed. A hyperboloid next gave a little trouble, and later a central hill had to be removed before getting the mirror back to a true figure.

"The focal length is 110 inches. I get a range of magnification of from 55 to 458 diameters, using various eyepieces. The definition is good; in fact it compares very favorably with that of the Zeiss telescope, which is a high grade instrument. The mounting is a combination of alt-azimuth and equatorial; we live on the shore of Lake Michigan and the equatorial is not so convenient for sweeping around the horizon. I now have the Zeiss refractor mounted on the same equatorial head and the combination makes a good appearance.

"The observatory is 12 feet in diameter and is built over the edge of a bluff 85 feet above the lake. The inside rests on a concrete retaining wall, and the outside is supported on heavy steel columns."

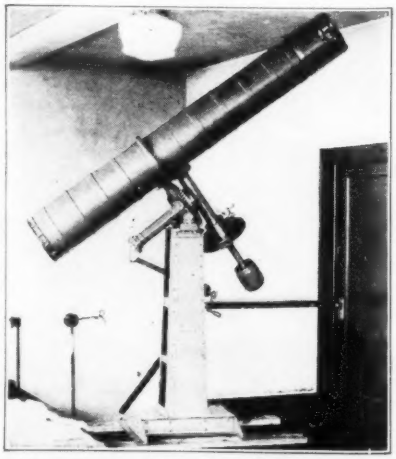
DR. BERT R. CARLSON, dentist, 4100 East Lake Street, Minneapolis, Minnesota, sends in several photographs of an especially neat appearing telescope completed by him. "The patterns for the castings," he writes, "were made at home but I performed the machine work at the shop of a former employer. Everything is brass except the tube and the ⅞ inch steel shafts. For the purpose I found that brass tubing was not stiff enough.

"The mounting without tripod weighs about 40 pounds and is none too heavy. It is intended for a column on a concrete base, which I hope will make it more steady. The declination and hour circles are part of the friction plates. The slow-motion member holds the vernier.

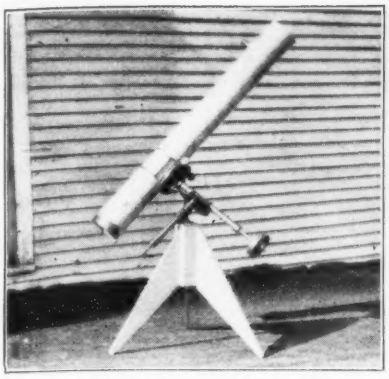
"I enjoyed the polishing. My first pitch lap was too soft and by the time I had learned to interpret the shadows in the shadow test the speculum was deeply hyperbolized, with a hole in the center that could be seen before the knife-edge cut off the light. It required seven hours and two pitch laps to bring it back to a sphere, but I learned a lot about shadows, strokes, and so on, in doing it. I believe it is better not to get a parabola by beginner's luck the first time, but to have to work for it. The instruction one thus gets is worth the effort.

"The mirror has a focal length of 53 inches and the entire instrument cost less than 50 dollars."

THE Fourth Annual Convention ("get together") of amateur telescope enthusiasts will be held Saturday, August tenth, at Stellafane, near Springfield, Vermont. Postcard invitations will no doubt be sent to amateurs in nearby states, but it is emphasized that all are welcome. You need no invitation, and if you should happen by some omission not to receive one, *come anyway.* These gatherings are for the main purpose of



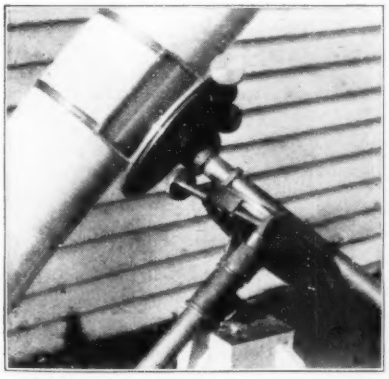
Mr. Ross's 12-inch reflector with adjustable polar axis. Weight of the instrument is 1000 pounds



Dr. Carlson's six-inch reflector

permitting amateurs to meet one another, trade ideas and experiences, and talk.

IN last month's issue we spoke of the possibilities of making an amateur hobby of seismology. No returns have yet been received as this is written, because that issue of the magazine is not quite yet before the readers. However, there is still

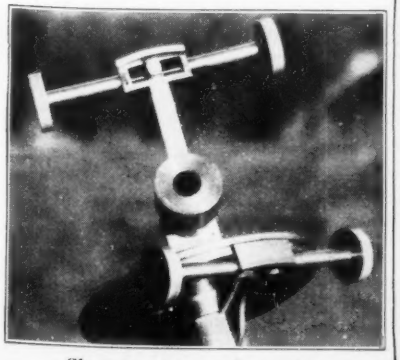


Details of axes and friction plates

another hobby which a number of our readers have suggested for popularization—amateur microscopy. It would not pay to make one's own microscope (although this might prove interesting if the practical instructions were available) because the market is nowadays full of suitable microscopes at a cost of only about 20 dollars.

Microscopy is a large subject, a "large order," too, for any editor who might rashly attempt to pose as an authority on it. Even one single aspect of it into which the present writer has slightly looked, that

(*Please turn to page* 182)



Slow motion and vernier

His answer was
"I Challenged an Axiom"

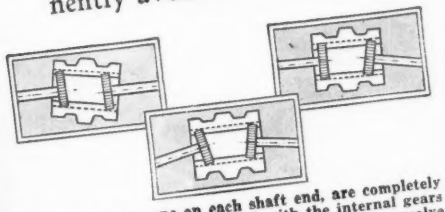
THAT is how Einstein explained it: How he knocked accepted mathematical limitations into a cocked hat—and laid down his theory of Relativity.

Fast's New Principle

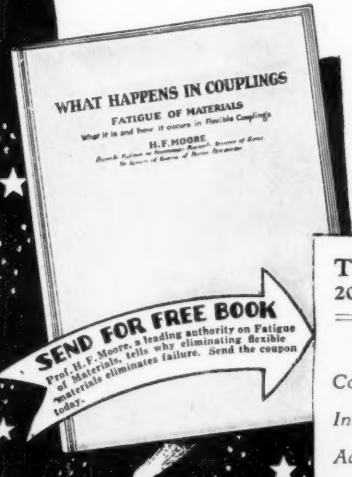
Fast challenged an axiom when he made a flexible coupling without flexible materials. Heretofore "shut-downs for repairs" were probable as long as old-type couplings used flexible materials. By eliminating all flexible pins, bushings, springs, discs and grids, Fast's Coupling banished coupling failures forever.

Why Risk Shut-downs?

Every old-type coupling in your plant is a danger-spot. Eliminate flexible materials from your power drives, and shut-downs for replacements are permanently avoided.



Two spur gears, one on each shaft end, are completely and continuously meshed in oil with the internal gears of a floating sleeve. The shafts and sleeve revolve noiselessly as one unit, allowing free angular and lateral movement.



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Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Automotive

FACTS AND FIGURES OF THE AUTOMOBILE INDUSTRY, 1929 EDITION, presents up-to-date data pertaining to manufacture, exports, registrations, highways, bus lines, and other aspects of the automotive industry. *National Automobile Chamber of Commerce, 366 Madison Avenue, New York.—Gratis.*

BUS FACTS FOR 1929 is a publication showing the amazing growth of the motor bus as a factor in transportation throughout the country. In addition to the other information presented, a list of bus companies is provided, with a map of the United States showing all major highways and those now served by established motor bus routes. *Motor Bus Division, American Automobile Association, Mills Building, Washington, D. C.—Gratis.*

Aviation

NOTICE TO AVIATORS, published by the Hydrographic Office under the authority of the Secretary of the Navy, is a monthly publication furnishing information about landing and port facilities, sailing directions, et cetera, which will assist aviators in aerial navigation. It is primarily for the use of naval aircraft, but contains much timely information useful in commercial or private flying in regions adjacent to oceans, bays, lakes, rivers, or other navigable waters. The Department of Commerce maintains a central distributing point for all aviation charts published by the United States Army, Navy, and the Department of Commerce, at the *Coast and Geodetic Survey, 119 D. Street, N. E., Washington, D. C.* Airway bulletins and Aeronautics Bulletins may be obtained from the *Aeronautics Branch, Department of Commerce, Washington, D. C.*

THEORY OF BALLOONING, prepared under the direction of the Chief of the Air Corps, Department of War, contains general directions, facts important in piloting a free balloon, and procedure to be followed in preparing a balloon, basket, and instruments for shipping. *United States Government Printing Office, Washington, D. C.—5 cents.*

Commerce

MERCHANT MARINE STATISTICS for 1928, a contribution from the Bureau of Navigation of the Department of Commerce, is a 76 page compilation covering American tonnage, world tonnage, American waterborne commerce, and American seamen. *United States Government Printing office, Washington, D. C.—15 cents.*

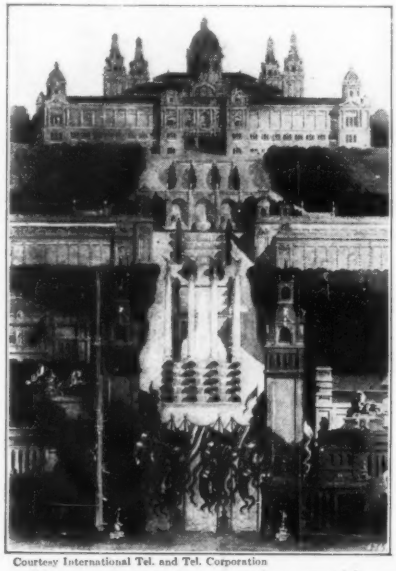
TRANSPORTATION CHARGES IN THE UNITED STATES AND CANADA contrasts the position of the Canadian railways with those in this country, particularly dealing with grain rates in the wheat-producing areas of the west. The case for the high rates on the privately-owned railroads of the United States is presented. *Association of Railway Executives, Transportation Building, Washington, D. C.—Gratis.*

THE UPBUILDING OF SOVIET RUSSIA describes the industrial and commercial expansion in the Soviet states, with the intention of showing that the obstacles interfering with Soviet-American trade will have to give way before economic realities drawing the two countries into more complete intercourse. *Amtorg Trading Corporation, 165 Broadway, New York.—Gratis.*

CURRENT ECONOMIC DATA PERTAINING TO THE PORT OF NEW YORK, Commerce Bulletin Number 1, briefly summarizes the activities of the world's greatest port. The bulletins, with up-to-date statistics, will appear monthly. *The Port of New York Authority, 75 West Street, New York City.—Gratis.*

INTERNATIONAL TRADE IN PETROLEUM AND ITS PRODUCTS is a booklet prepared by the Petroleum Section, Mineral Division, Department of Commerce, with the co-operation of the American Petroleum Institute. *United States Government Printing Office, Washington, D. C.—25 cents.*

IBERO AMERICA, a souvenir booklet issued to commemorate the Ibero-American Exposition in Seville and the International Exposition in Barcelona, might serve as a text-book in commercial geography. With well chosen illustrations and brief but intriguing sketches of the background and commercial standing of each country, the reader is carried from Spain and Portugal to Argentina, Bolivia, Brazil, Chile, and all of the other countries of the Americas, concluding with the United States, Uruguay, and Venzuela. Published in English and Spanish by the *International Telephone and Telegraph Corporation, 67 Broad Street, New York.—10 cents.*



Courtesy International Tel. and Tel. Corporation

Main entrance to the world-famous exposition at Barcelona, Spain. The Ibero-American Exposition is being held concurrently

BRITISH CHEMICAL TRADE IN 1928, issued by the Department of Commerce as Trade Information Bulletin No. 621, shows the recovery of the British chemical industry from the trade depression of 1926, with considerable expansion and centralization which is expected to continue favorably during the present year. *United States Government Printing Office, Washington, D. C.—10 cents.*

PEANUTS, a report of the United States Tariff Commission to the President, contains the proclamation of ex-President Coolidge raising the tariff to protect American peanut growers from competition with Chinese peanut growers. The report covers almost all phases of the peanut industry, with special attention to the differences in costs of production. *United States Government Printing Office, Washington, D. C.—15 cents.*

Communication

RADIO, a booklet edited by Irwin Stewart, is an interesting volume in which a group of experts has attempted to portray in non-technical language a picture of the entire field of radio. Two chapters are devoted to the development of radio, three to the present status, two to federal legislation and administration, four to the various services performed by radio, and five to its place in international affairs. The booklet is well indexed. *American Academy of Political and Social Science, 3622 Locust Street, West Philadelphia, Pennsylvania.—Paper, one dollar; cloth, one dollar fifty cents.*

AIRWAYS COMMUNICATION SERVICE, by Edward B. Craft, is a discussion of the various communication requirements of aviation and of ways for meeting these needs. *Bell Telephone Laboratories, Inc., 463 West Street, New York.—Gratis.*

Investments

UNITED STATES LINES, INC., is a well-prepared review of the activities of this company, presented to prospective investors. The booklet is illustrated with photographs showing interior scenes on the S. S. *Leviathan, George Washington,* and other famous liners of the fleet. *P. W. Chapman and Company, Inc., 42 Cedar Street, New York—Gratis.*

CRUDE RUBBER is the title of a little booklet containing statistics on many phases of the rubber industry, including production, plantation areas, imports, consumption, and prices. It also has maps showing the important rubber-producing regions. *H. Hentz and Company, Hanover Square, New York.—Gratis.*

REPORT OF THE FEDERAL RESERVE BANK OF NEW YORK, for the year ended December 31, 1928, shows where our money goes and how we get it back, particularly in the realm of international finance. The much-discussed Federal Reserve policy is explained in brief. *Federal Reserve Bank of New York, 33 Liberty Street, New York City.—Gratis.*

WATER, THE INDISPENSABLE UTILITY gives a detailed description of a water company's plant and operations, with special reference to the investment values of securities of water companies. *G. L. Ohrstrom and Company, 44 Wall Street, New York.—Gratis.*

Miscellaneous

GREEK-ROMAN TREASURES OF GERMAN MUSEUMS is a beautifully illustrated introduction to the ancient works of art which are being preserved in the museums of Germany and Austria; a companion publication to appear soon will deal with the art of the Far East, as represented in the central European museums. *Terramare Office, Wilhelmstrasse 23, Berlin S. W. 48, Germany.—25 cents.*

PARASITES AND THE AID THEY GIVE IN PROBLEMS OF TAXONOMY, GEOGRAPHICAL DISTRIBUTION, AND PALEOGEOGRAPHY, by Maynard M. Metcalf of Johns Hopkins University, treats the ever-interesting problem of parasites and their hosts from a broad viewpoint but with well-documented references and a good bibliography. *Smithsonian Institution, Washington, D. C.—Gratis.*

COST OF PROHIBITION AND YOUR INCOME TAX, one of the pamphlets issued by the organization seeking legal means of altering the present liquor situation, is a compilation of statistics intended to show from government figures that the "noble experiment" costs 936 million dollars a year. *Association Against the Prohibition Amendment, National Press Building, Washington, D. C.—Gratis.*

FAMOUS DIAMONDS, by Oliver C. Farrington, presents the essential facts and the interesting history of such great diamonds as the Cullinan, Dresden Green, Great Mogul, and the Kohinoor. The latter has been famous for centuries, and legends tell of its early history in southern India four or five thousand years ago; in 1526 it was appraised by an expert in diamonds as being worth "half the daily expense of the whole world." *Field Museum of Natural History, Chicago.—25 cents.*

SELF HELP FOR COLLEGE STUDENTS, issued by the Federal Bureau of Education, shows how one half of the men and one fourth of the women in colleges and universities of the United States are paying for their education by working during term-time. *Bureau of Education, Department of the Interior, Washington, D. C.—Gratis.*

ONE MILWAUKEE DIE CASTING

The top illustration shows the Climax Sprinkler, and presents a clear view of the top surface of the die-cast rotary.

The lower illustration presents the bottom view of the die-cast rotary alone.

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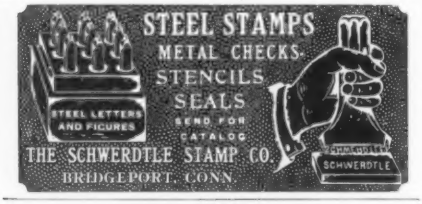

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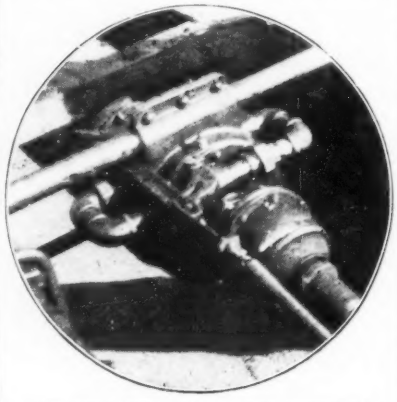
The Scientific American Digest

(*Continued from page* 163)

then hooked up enough motive power to handle it, it would require a million engines and a similar number of caboose cars to furnish housing for the train crews necessary to handle the train, and incidentally it would take a crew three times as large as the entire population of Chicago to run it. Using a conservative length for each unit of this composite train, we would have 10,000 miles of locomotives, 390,732 miles of train and 5685 miles of caboose cars, an over-all length of 406,417 miles. Routed west through Chicago and reported on block 7:00 A.M. this morning, traveling 30 miles per hour, it would require approximately 564 days and 11 hours to clear the block, having wrapped itself around the world more than 16 times enroute. This train represents the growth of freight transportation in 100 years, and yet some people claim the romance has gone out of railroading."

True Hydraulic Automobile Brake

IN a hydraulic brake manufactured by F. L. Barris of San Francisco, the braking effect is produced within the brake itself and not transferred to brake bands. The brake is in the form of a rotary pump which is keyed to the drive shaft back of



The true hydraulic brake mounted in the chassis of an automobile

the transmission and which, when the brake is on, pumps oil through a very short closed circuit in which is located the control valve. The braking pressure is established by closing down this control valve so as to place an excessive back pressure on the oil pump.

The blades of the pump are withdrawn and held within the inner rotor when the brake is in the off position, thus producing no pumping action, circulation of oil, or pressure of any kind. When the brake is required for service the blades are instantly released and the braking pressure established at once.

The control is by means of the usual foot pedal, more or less braking effect being produced as the foot pedal is moved forward or back. The braking effect is the same, forward or backward. No pressure is carried when the brake is in the "off" position and since the brake bands, with their attendant rods and connections, are eliminated, it follows that there are no brakes to be relined or adjusted.

The braking effect does not change from time to time, as when brake shoes and

Service

BUSINESS today is based upon service. The grab and run manufacturer is almost extinct. Advertising has played its part in his passing. By contrast with the open methods of others, it has thrown his operations into such sharp relief that it has left him no recourse. His failure was inevitable.

People have come to depend upon consistently advertised merchandise. They have confidence in the manufacturer who places himself on record month after month as to the merits of his product. They know he will maintain that product at the standard he has set, not only for their protection but for his own. Should he drop below, the buying public would soon discover it, and his business would be faced by ruin. No manufacturer who is spending large sums to produce, advertise and sell an article is going to take that risk.

Quality, utility and value are the things uppermost in the mind of the advertiser today. Improving his product, making it more useful to you, giving you greater value for your money, these are his aims. When he succeeds, he tells you about it—in the advertisements.

If you neglect the advertisements, you are missing one of the most vital features in this magazine.

brake lining are used, but remains the same at all times, as there is nothing to wear out and no adjustments to be made. The brake is self-oiling and therefore requires almost no attention.

In addition to the automobile, this system adapts itself to many other machines where brakes are required.

Ant "Cowboys" Faithful to Their Insect Cattle

THAT ants, like humans, have cattle, is an old story, but the faithfulness with which they attend their little green "cows" has had a new light shed on it by the researches of Dr. Herman Eidmann, of the University of Munich. Charge over a given herd of aphids is not turned over to any chance ant out of a nest, but to certain designated individuals, and these return day after day to the same twig where their particular aphids are feeding. There they watch over them, drive off or kill strange ants, and protect their herds from other natural enemies.

Dr. Eidmann learned that the same ant returns to the same twig full of aphids regularly by the simple trick of putting dabs of colored paint on the ant herdsmen, and corresponding paint spots on the twigs where he first saw them. After that he found the colors on ants and twigs matching without fail every day. So faithful were the six-legged cowboys that when the weather became warm enough they frequently remained on the twigs all night instead of returning to the nest. And although the species under observation is one that ordinarily avoids the light, the members of the colony that had the job of aphid-herding assigned to them would patrol their twigs in the full glare of the midday summer sun.—*Science Service.*

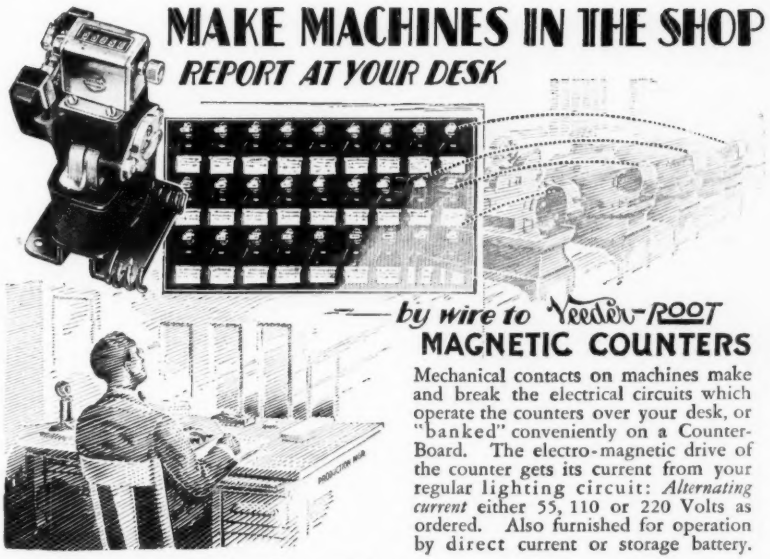
Tunnel Yields Its Cost in Gold

GOLD struck in tunneling an aqueduct for Manila more than equals the cost of the undertaking. The 9000-foot vein was recently estimated to contain 20,000,000 dollars worth of ore. No particular surprise was occasioned, for within a thirty-mile radius of the Philippine capital at least two gold lodes and several areas of placer ground had already been located.

Since Spain ceded the islands to the United States in consideration of Dewey's victory and 20,000,000 dollars cash, the Philippines have yielded in gold alone 23,767,000 dollars. Silver is usually found alloyed with the gold, and the annual output of minerals now is nearly 5,000,000 dollars in value.—*New York Times.*

A 50,000,000 Dollar Pest

IT costs in the neighborhood of 50,000,000 dollars a year for cattle owners, dairymen, feeders, butchers, and tanners to support the cattle grub, yet this pest can be destroyed. Either the old method of hand extraction may be used, or the newer methods developed by the United States Department of Agriculture. The department advises the application of Derris as a wash, ointment, or powder, pyrethrum ointment, fine tobacco powder or nicotine dust, or the injection of benzol or carbon tetrachloride. A concentrated drive on the cattle grub is necessary to eradicate it from a locality. The pest is becoming more serious, says the department, owing to the spread of a second species of grub, known as the northern, or European, grub.



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The Amateur Astronomer

(*Continued from page* 177)

is, the study of the microscopic living forms of life in pond water, ditches and streams, is too broad a subject for any but a whole-time specialist to encompass.

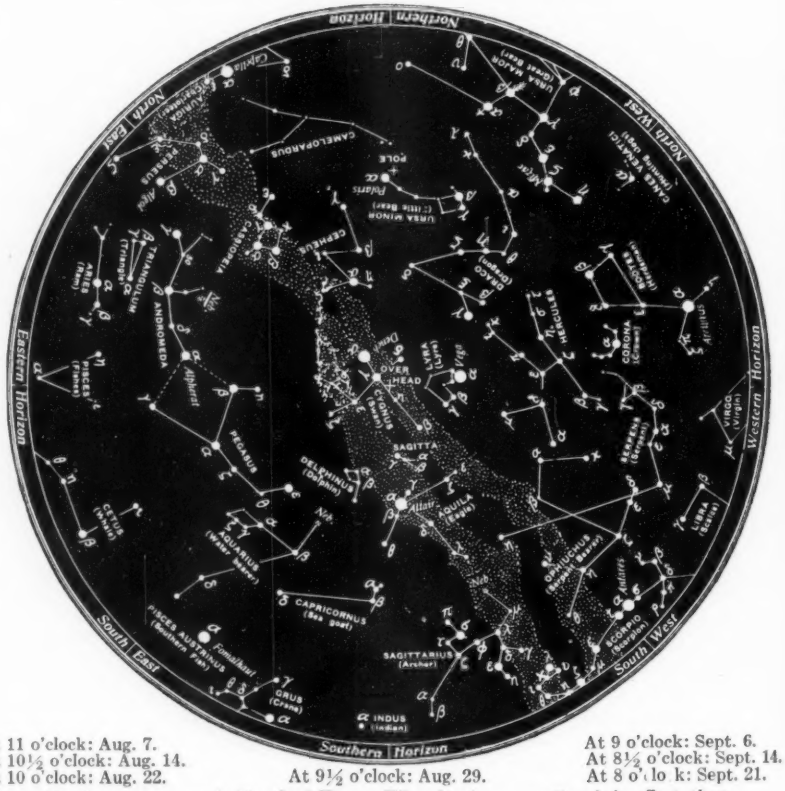
However, this one phase of microscopy affords a most fascinating field for the scientifically inclined amateur.

Few people realize the immense number of interesting live forms of microscopic life to be found in half a drop of pond water. One can remain for hours watching the antics of an amoeba, or the beautiful rotational motion (which is really an optical illusion) of a rotifer. One other form, less animated, the diatom, is the subject of an article in the present issue, and the reader's attention is called to the footnote placed beneath that article (page 113). These and hundreds, yes thousands, of other forms are widespread in their distribution; in fact they vary little throughout the world, because they are so easily transported by natural agencies. You will find them in the average ditch; in the river, creek, and brook; in the old swimmin' hole; and doubtless in the tap water in your kitchen.

A microscope which magnifies more than 100 diameters will suffice very nicely to render them visible, and a few old bottles and inexpensive gadgets complete the outfit. How many readers are sufficiently interested in this outdoor hobby for the amateur scientist to write in and say so?—*A. G. I. Tel. Ed.*

The Heavens in August

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.
At 9½ o'clock: Aug. 29.
At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on August 7, etc.

NIGHT SKY: AUGUST AND SEPTEMBER

MERCURY is an evening star, too near the sun to be seen at first and low in the twilight, even at the month's end when he sets about 7:30 P.M. (by Standard, not by Daylight Saving, time). Venus is a morning star, rising at 2 A.M. in the middle of the month, and is very conspicuous. Mars is an evening star in Leo and Virgo, setting about 8 P.M. Jupiter rises at 12:45 A.M. on the 1st and 11 P.M. on the 31st. He is in Taurus, and next to Venus is the brightest thing in the morning sky. Saturn is in Ophiuchus and is the only planet which is well visible in the evening. He comes to the meridian about 10 P.M. in the middle of the month and is at his brightest, since his rings are seen at the most favorable angle. Uranus is in Pisces, observable in the morning hours; and Neptune is in conjunction with the sun on the 24th and is invisible.

The moon is new at 11 P.M. on the 4th, in her first quarter at 1 A.M. on the 12th, full at 5 A.M. on the 20th, and in her last quarter at 3 P.M. on the 27th. She is nearest the earth on the 3rd, remotest on the 16th and nearest again on the 31st. As she sweeps round the sky she passes near Jupiter on the 1st, Venus on the 2nd, Mercury on the 5th, Neptune on the 6th, Mars on the 7th, Saturn on the 10th, Uranus on the 23rd, and Jupiter again on the 28th, thus rounding out her cycle.

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Chemistry in Industry

(*Continued from page* 174)

alkali and some soap, says Arth R. Maas in his jolly little house organ, *Chemistry and Us.*

The alkali cuts the grease. The soapsuds thin it into a "soup" called "dishwat r." Some of this "soup" is left on the dishes, as a film.

That's what drives customers away.

When the chemist washes dishes, he wants at least three big pans.

In the first, he puts hot water and a cleaning compound with a tri-sodium-phosphate base. This cleaning compound takes up the grease in colloidal suspension, instead of thinning and spreading it around.

A second pan of hot water, with a weaker solution of the compound, makes the dishes quite clean. A third pan of hot water alone rinses them so they dry bright, without wiping.

Peroxide Also Bleaches Cereals

ONE of the most striking examples of the penetration of refined chemical methods into all branches of industry is the introduction and extensive use of peroxides in the cereal industries. Benzoyl peroxide, some years ago known only to a small number of chemists and familiar to hardly any one of them, is now widely used by millers, not only in the United States but in all countries of the world.

G. Van der Lee, writing in a recent issue of *Food Industries*, describes the bleaching of flour as an oxidation process and explains why the action of oxygen in the atmosphere does not perform the bleaching action as well. The answer is that flour is indeed bleached to a small extent by exposure to the air. This natural bleaching, also called aging or maturing of flour, has been known to millers for a long time.

However, as the oxygen in the air is in an inactive state, a much less intensive bleaching was obtained, even after prolonged contact. For this reason the fact that chemistry has developed a method to intensify the oxidizing power of the atmospheric oxygen by converting it into a solid compound, from which it is easily released in an active form, may be considered as a long step forward. The uncontrollable and time-consuming aging and maturing of flour by nature thus has been superseded by a safe, rapid, and far more effective process based on scientific principles.

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WE have often wondered how the lamp peddler of Arabian Nights fame made a living with his policy of "new lamps for old." Perhaps he was simply the forerunner of the trade-in plan, since popularized by automobile dealers, but we prefer somehow to accept the more colorful explanation that he possessed some magic secret that enabled him to rejuvenate battered old lamps by a mysterious incantation. Such a theory is hardly more fantastic than the former, prosaic one, in the light of an apparatus recently introduced to make new lubricating oil out of old. Looking for all the world like an overgrown electric refrigerator, this modern magician is fed dirty, dilute, crank-case oil, and without more than occasional supervision by human beings, steadily delivers a

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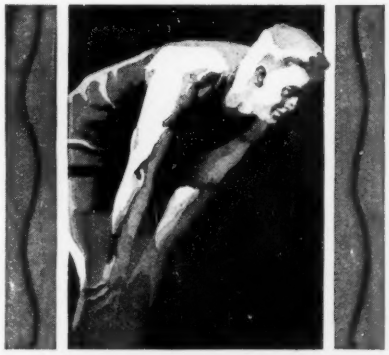

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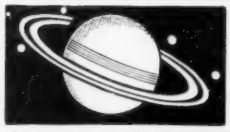

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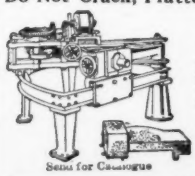

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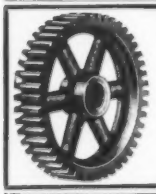

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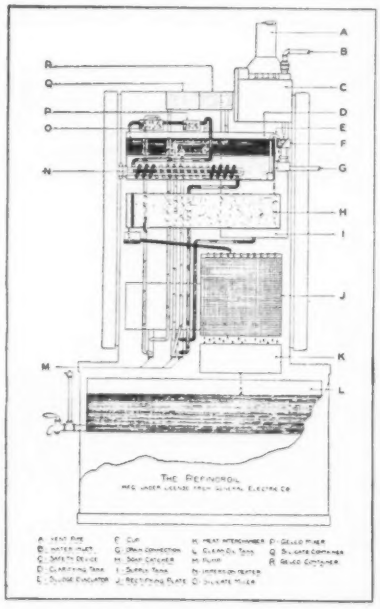
The principle of this oil reclaimer was explained by SCIENTIFIC AMERICAN four years ago, when it was first developed by the General Electric Company. It is a far cry, however, from the first crude application of the principle to the modern, foolproof, and automatic installation now being marketed by the Refinoroil Company, of Elmira, New York. Briefly, its operation is based on the fact that lubricating oil does not "wear out" in service, but simply undergoes certain changes, rectification of which, together with the removal of accumulated dirt and carbon, leaves it as good as new.

The most important underlying principle of the process is the remarkable effect which silicate of soda (water glass) has been found to have. Chemically, this substance functions as an alkali, and as such its action is probably not different from that of any other alkali. It is the physico-chemical character of the sludge produced in the oil by shaking with the concentrated



Oil reclaiming apparatus using "water glass" and an inexpensive chemical called "Gelco" for clarification and rectification of used lubricating oil. The rectified oil is redeemed at a total cost of about ten cents a gallon. Reclaimed oil is said to be "as good as new"

solution of the silicate that sets it apart from any other material, and that alone has made practical the development of an automatic, continuous machine.

Reclamation by this system is effected in two steps: clarification and rectification. The oil is first treated hot with a small quantity of an inexpensive chemical called "Gelco," followed by the addition of an equally small amount of concentrated silicate of soda solution. In this way a sludge is formed which carries all solid and other impurities, even when present in microscopic or colloidal form. This sludge settles quickly, sinking into an underlying body of water which is constantly being pumped out and replaced by fresh water. The diluents are next removed by passing the clarified oil in a thin film over electrically heated plates in a lively current of

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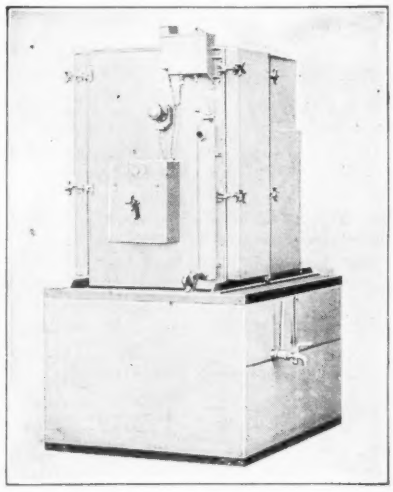

Exterior view of the electrically-operated machine used for removing impurities from used lubricants

air. This method was adopted, inasmuch as rectification of diluted oil, by heating in bulk, requires temperatures well in excess of the figure at which rapid oxidation of the oil begins.

The machine, which is shown in the accompaning illustrations, is designed for 24-hour operation without attention, and all containers are built large enough to accommodate the various liquids for even longer. The apparatus is self-contained, so that no separate tanks are required. The supply tank in the machine is filled with dirty oil once a day. At the same time the chemical containers Q and R are filled with silicate and "Gelco" respectively. No measuring is required, the containers simply being filled to the top. A few moving parts in the machine are operated by a one tenth horsepower motor.

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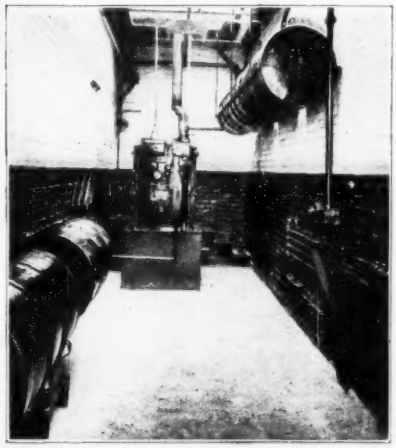

Installation showing an oil-reclaiming machine, with auxiliary storage tanks, located at a large motor bus terminal in Boston

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Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Employer Restrained From Using Patent

MERELY because an inventor was in the employ of a company at the time his invention was being perfected, provides no cause for the employer to think that he has a license in the invention. In the case of Anton I. Sanbo *versus* the Bear Manufacturing Company, the plaintiff was granted an injunction prohibiting the defendant from further manufacturing and selling his patented device, and from further infringing his patent covering a flat bar type wheel alignment indicator.

An agreement had been made wherein the inventor was to have a royalty for each product manufactured, equal to twice the cost of the materials entering into the completed device. It was also agreed that there were to be frequent statements and accountings, and that any money advanced to the inventor was to be deducted from his royalties.

The defendant contended that it was entitled to an implied license in the invention by virtue of having been an employer of the plaintiff at the time he made the invention. The company also contended that Sanbo had been hired to work for it as superintendent of its machine shop, and that fact entitled the company to manufacture any of his inventions. It was further pointed out by the defense that the inventor was a stockholder and a director of the corporation manufacturing his device, and that his invention should therefore belong to the corporation.

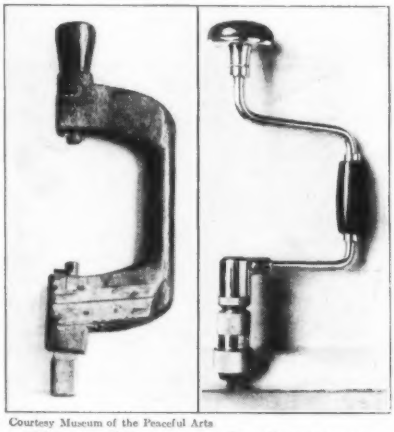
These contentions were disproved, in the opinion of the court, by reason of the fact that there had been a clear understanding between the parties as to their rights. The law governing the rights of an inventor to his invention has long been established, and the mere fact that one is a stockholder, director, or officer of a corporation does not give the corporation any property right in the invention except in cases where there are substantially such relations existing between the person employed and the corporation as would give the corporation a right to the patent because the inventor is an employee.

The Patent Attorney—Friend or Enemy?

UNETHICAL conduct on the part of certain patent attorneys, whose practices place them on the level of auctioneers and vendors of patent medicines, has resulted in the establishment of a code of ethics for the members of the American Patent Law Association. Advertising methods approved by the Association consist of soberly-phrased announcements and business cards conforming to the standards of good taste and propriety one expects in the professions.

Replying to a questionnaire sent to a large number of judges throughout the United States, the judges expressed the opinion that most cases of unethical conduct in connection with inventions and patents could be attributed to attorneys handicapped by youth, inexperience, and ignorance. An unofficial observer might comment that another reason is the prevalence of "go-getter" patent attorneys of the type specializing in great promises and small results. But the common fault is inexperience in the exceedingly intricate procedure to be followed in handling patent cases. Realizing the advantages possessed by patent specialists of long standing, many lawyers without patent experience safeguard the interests of their clients by placing such matters in the hands of reputable patent attorneys.

"A normal baby is usually a phenomenon to its parents. The average inventor feels



Courtesy Museum of the Peaceful Arts

This striking example of progress during the past 200 years forms part of one of the many interesting exhibits at the Museum of the Peaceful Arts, in New York City

the same thrill," according to an editorial in a recent issue of *Engineering and Mining Journal*. To save useless time and work it is usually to the advantage of an inventor to discuss with his patent attorney the idea on which he is working. In many cases the advice of an attorney will be of primary importance; the idea may be an old one, with which the prospective inventor would be merely wasting his time. Or he may have conceived an invention of great importance, the significance of which can be best judged by a specialist in the field of invention and patent protection.

Coincidences occur in many unexpected places, and it may be that two or more inventors are engaged in perfecting the same device at almost the same time. If both file patent applications covering the same invention, the Patent Office declares an interference, and it is the duty of the inventors and their attorneys to prove which of them is entitled to the patent. In the absence of contrary proof, the law considers the man who first files an application the inventor.

A preliminary investigation of the prior patents in any particular field may show that the invention is already known, and is probably unpatentable. In many instances valuable information may be found by studying the files in the Patent Office. A more complete examination is made by the Primary Examiner at the Patent Office when the application is received.

If the Primary Examiner points out earlier patents which would invalidate the claims, it is the business of the attorney representing the petitioning inventor to show that the citations do not anticipate the invention in question. Certain claims may be rejected and others allowed; if certain claims are allowed and a patent is issued, the inventor receives a 17-year monopoly covering the use of the claims. If any question of validity arises, the courts must decide if the patent was granted legally. For this reason, it is essential that the application be prepared by an attorney qualified to draw up the papers with faultless phraseology and such well-grounded claims that the patent will withstand any legal battering that may ensue.

Health Food for Fido

THE inventor of an improved dog biscuit has been granted a patent for a product that is rich in vitamines, is preserved from deterioration by a hard glazed crust, and has a longitudinally concave-convex shape. Although the addition of vitamines to food is not new, no one had previously added them to a food to be baked, and so shortened the baking time and modified the baking temperature that the vitamines are conserved and protected by a hard glazed crust. The novel shape serves a useful purpose, for it is easily grasped by the dog when the convex side is upward, or when the concave side is upward it can be easily tipped to a more suitable position for the dog to grasp and bite it.

"Walker on Patents" Revised and Enlarged

THE first edition of "Walker on Patents" was published in 1883 and subsequent editions were published at irregular intervals. For the maintenance of his book as a permanent up-to-date authority on the law of patents for inventions, the author provided that at proper intervals a committee was to select a prominent patent lawyer to revise and enlarge the work and thus maintain it as the standard text-book on the subject. Confronted with the need for a new edition, the committee selected Mr. John L. Lotsch to edit, enlarge, and make the necessary revisions.

Mr. Lotsch's devotion to his task is an honor to the original author and a complete justification of his selection by the committee. He has spent over two and a half years on his revision of the book and the sixth edition has retained all the con-

spicuous and acknowledged merits of the former editions, while many of the defects and imperfections which impair the usefulness of the work have been removed. Abundant new matter has been added and includes the only completed digests of all cases by the U. S. Supreme Court and the nine Circuit Courts of Appeal of the United States.

The new edition presents in a clear, concise, and simple manner every phase of patent law. The book will be very helpful to the Bench and Bar, and will interest many laymen as well as inventors, manufacturers, and investors in patents.

Inventions of Famous Italians Exhibited

FEW nations have so rich an heritage as that proudly borne by Italy during the past 25 centuries. Always a leader in the fine arts, it has also produced some of the outstanding figures in the field of science and invention. Of these, Leonardo da Vinci and Galilei Galileo occupy places of first rank. Sharing honors with the world-famous inventors of the present generation, these scientific pioneers are the recipients of the plaudits of their countrymen who visit the National Italian Exhibition of History and Science recently opened by King Victor Emanuel in the city of Florence.

Among the exhibits are the oldest telescope in existence, built by Galileo in 1600, and models made from designs by da Vinci of the first flying machines conceived by man. Other models of scientific interest include the first condensation hydrometer, for measuring the humidity of the atmosphere, which was invented by the Grand Duke Ferdinand; the first pendulum clock, invented by Galileo and constructed by Vincenzo; the first thermometers, made by Accademia del Cimento; the first barometer, by Torricelli; and the first immersion microscope, by Amici. Models of da Vinci's parachute, helicopter, and lathe are also on exhibition. Great interest has been shown in the model of an internal combustion engine, made by the monk, Father Barsanti. Many modern inventions are also on display at the National Italian Exhibition, but public interest is focused on the remarkable devices produced more than 500 years ago.

Wanted—A Budding Genius

WHETHER or not the young man to be selected by Thomas A. Edison as his "successor" turns out to be another genius, the far-reaching effect of the competition will stimulate many young inventors. With the announcement that Mr. Edison is canvassing the nation for a young man who can carry on the great inventor's work, all young men with leanings toward mechanics, chemistry, radio, and kindred branches of science have begun to wonder how even a genius can pick a genius.

The young men whose minds have wandered to such thoughts have been in distinguished company, for *Science Service* engaged a number of prominent psychologists to discuss the same question. Forty-eight promising students, scholastic science leaders of their states, will be selected by their governors and sent to the famous Edison laboratories in West Orange, New Jersey, for examination. They well be subjected to a questionnaire, and the winner will receive a scholarship, accompanied by the usual round of honors with which the public awards its heroes, bathing beauties, athletes, and visiting delegates.

Dr. Donald A. Laird of Colgate University doubts if Mr. Edison will uncover a genius of his peculiar caliber, but thinks such a contest will stimulate many young inventors. "His questionnaire will give an approximate measure of the practical general intelligence of the candidates, which is important for inventive genius," in the opinion of Dr. Laird. "But how to measure the emotional drives and real desire for achievement which are also important is still a problem. These non-intelligence factors may be more necessary than mere knowledge and intelligence."

Louis M. Terman of Stanford University, author of "Genetic Studies of Genius," is of the opinion that "it is possible to identify with considerable certainty the youth who is endowed with scientific talent. But," he adds, "the whole bet should not be staked on one horse. If the ten most promising are selected and trained, Mr. Edison will have a better chance of finding ultimately the one individual he wants."

Dr. Knight Dunlap of Johns Hopkins University says, "How would I pick a single genius? I wouldn't. I should pick out a quartile of the class making the best school record . . . but which of these would prove to be a major contributor to the world's progress no one could predict. Mr. Edison might just as well take the brightest boy in Jersey City or in Lancaster and give him the opportunity of becoming an electrical wizard as to carry the quest through 48 states and attempt to pick a potential genius."

"Genius comes in many different forms and there is no general type," according to Dr. Arnold Gesell of Yale University. "Edison has one kind of genius, Einstein another, Kreisler still another. Deliberately to go about finding a successor for any great man it would be necessary to make an inventory of the actual qualities desired and to specify the particular combination in which they are preferred. Genius comes in patterns, not in doses."

Agreeing with several of the other noted psychologists that great care should be taken in choosing the tests to be used on the candidates, Dr. Walter V. Bingham, President of the Psychological Corporation, is of the opinion that Mr. Edison's well-known questionnaires are not sufficiently reliable. With a well-selected series of tests it may be possible to find a mind like Edison's, if there is such a mind in the group, according to Dr. Bingham. But probably he reflects the thought of many others when he frankly states his opinion as to the futility of the search. "There can be no successor to Edison. In his place there will be a whole group of investigators working together. The day has passed when one inventor, no matter how brilliant, can outstrip the organized co-operative efforts of a great research laboratory. But such laboratories need young men of precisely the type Mr. Edison is seeking."

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co.; those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Designs

DESIGN FOR LACE—Patent 78429. Ben. A. Ball.

DESIGN FOR A SIGN NOVELTY—Patent 78366. Stanley J. Shepard.

DESIGN FOR A COMBINATION BATHROOM FIXTURE—Patent 78498. John H. Balmer.

DESIGN FOR A STOCKING—Patent 78524. Ruby Lefi.

DESIGN FOR A LAMP—Patent 78505. Henry O. Czech.

DESIGN FOR A HANDKERCHIEF DISPLAY RACK—Patent 78574. Evelyn L. Hill.

DESIGN FOR A LAMP—Patent 78578. Paul Kornan.

DESIGN FOR A LENS CLIP OR SIMILAR ARTICLE—Patent 78594. Vincent Tanassa and Jacob J. Pomeranz.

DESIGN FOR A JEWELRY DISPLAY BASE—Patent 78568. Leo Flier.

Chemical Processes

PROCESS OF TONING BLUEPRINTS GREEN—The blue image being composed of ferrous-ferricyanide, the prints are subjected to a solution of uranium salts, potassium ferri-cyanide, and acetic acid, until the blue turns to a green, and then washed in water. Patent 1712428. Rudolf Fritsche.

MINERAL FEED AND PROCESS FOR MAKING SAME—For animals, which comprises heating rock phosphate and acid sulfate to a temperature above 300° C., cooling the mixture, and adding water, limestone, charcoal and salt to form a paste, to be cut and dried into pellets. Patent 1712404. Virgil R. Rupp.

Electrical Devices

ELECTRIC FURNACE—For producing calcium carbide from a mixture of lime and carbon, at the same time allowing the waste heat and products of combustion to be utilized for treating shale, so that liquid hydro-carbons may be gained as a by-product. Patent 1711088. Hilliary Eldridge.

TIME SWITCH—So arranged as to allow an alarm clock to close an electric circuit at a predetermined time, to open the circuit at a later time, and to intermittently operate as for show windows or advertising schemes. Patent 1710111. Manuel H. Rodrigues.

ELECTRIC LAMP AND SHADE ADJUSTER—Which may be associated with the conventional electric lamp and shade and will provide a means whereby the lamp and shade may be adjusted to throw light in any direction. Patent 1714369. Frederick A. Howe, Jr. and William Hinchliffe.

CONDUCTOR-RETRIEVING DEVICE FOR VACUUM CLEANERS—A device capable of being incorporated in a vacuum cleaner of any conventional form, for retrieving the electrical conducting cord so that it may be varied at will as

the cleaner is moved about a room. Patent 1714225. Parke S. Hyde and Damon P. Raynolds.

SWITCH PLATE—A glass switch plate, adapted for a duplex receptacle switch and having a structure for receiving a fastening screw for holding the plate in position and without engaging the fastening screw with the glass. Patent 1715222. Nathan Chesler.

MOTOR AND MOTOR SWITCH FOR FLASHERS AND THE LIKE—For different electric devices, such as flashers for signs, and the like, so constructed as to be readily adjusted to cause the flash to move at different speeds, and to use a minimum amount of current. Patent 1714321. Stephen H. Sharpsteen.

Of Interest to Farmers

FENCE POST—Having a self-locking means for securing fencing materials in position in a quick and easy manner, several of the horizontally disposed portions of fencing being simultaneously secured in one locking movement without the use of extraneous fastenings. Patent 1714388. James McBride.

Of General Interest

LOOSE-LEAF BINDER—Having rigid telescopic connecting members in place of the usual straps, connecting the members directly to the top and bottom cover sections and the back by resilient elements which operate automatically to adjust the covers. Patent 1710450. Frank H. Crump.

EYEGLASS CLEANER AND POLISHER—Having bulged pockets, supported on pivotally connected arms, for the reception of the thumb and finger of the hand, so as to press said pockets against opposite surfaces of an eyeglass for polishing purposes. Patent 1712325. David Brandfon.

DESIGN GENERATION—By an instrument of the kaleidoscope type, whereby various units of a design may be produced not only as suggestions, but may be preserved exactly as they appear, except possibly for variations of color, by photography. Patent 1712431. Walter C. Hadley.

COMBINATION SHELF AND CLOTHESRACK—Which may be readily inserted in a clothes closet or locker and the clothes held free from the walls so that air may circulate therethrough, and any article removed without disturbing others. Patent 1711854. Milton M. Olander.

CLINGING FIGURE—Having flexible limbs extending therefrom and suction cups formed integral with the extremities thereof whereby the suction cups constitute both hands and feet simulations and surface attaching means. Patent 1710989. Andrew Kelly.

HAIR CURLER—Consisting of a single piece of material foldable into two sections for enclosing a portion of hair and firmly grasping all the hair ends, thus curling the hair clear to the ends. Patent 1710216. Edna L. James.

CASEMENT WINDOW—So constructed that it may be hung with a minimum amount of labor, and which has means for supporting itself in the window frame to permit the carpenter to use both hands in securing the sash. Patent 1710171. John Lindsay.

COMBINED REFRIGERATOR AND DISPLAY STAND—Having a plurality of slidably mounted baskets for displaying fruits and vegetables in such manner that the air may circulate freely therethrough, and a refrigerating compartment for housing such articles as are easily destroyed by exposure. Patent 1711921. Norton H. Connell and Mion McMahan.

COMBINATION DISHPAN — A combination rectangular pan for washing and draining, comprising two sections adapted for arrangement within a kitchen sink, one section presenting a receptacle for washing water, the other having a perforated bottom supported on legs, for draining. Patent 1711731. Mathilde Hein.

RING—In which a plurality of annular sections are rotatably joined together for displaying various combinations of stones, the ring is of neat and attractive appearance devoid of projections on either inner or outer surfaces. Patent 1712417. George Beaujard, Jr.

PRICE TICKET HOLDER—Which may be quickly attached to and detached from a suitable support, the price ticket or card readily inserted or removed, and the whole manufactured with economy as regards material. Patent 1712423. Francis Devins.

FACE PACK—Constructed to snugly conform to and completely cover the chin and face sides, for treating the face with hot and cold applications to soften the beard incident to shaving, yet leaving the operators hands free. Patent 1709936. Wilbert L. Drew.

VALVE—Particularly adapted for controlling the flow of water to a fire hose, it may be adjustably set to prevent the delivery of fluid therethrough above a predetermined pressure, and locked against unauthorized tampering. Patent 1712298. Thomas B. Ford.

JEWELERS' IMITATION-GEM DISPLAY BOOK—The leaves of which are provided with apertures so correlated that as each leaf is displayed the stones of all the leaves therebeneath, as well as the stones attached, will be exposed to view. Patent 1709937. Charles E. Everard.

FURNITURE - COVERING - PAD CONNECTER—Which, in addition to securely locking a plurality of table cover sections in co-related or adjusted position, includes means for readily effecting the release of the sections. Patent 1712320. Jacob Zitzerman.

PROPELLER GUARD—A pair of cages, adapted to be removably secured on either side of the propeller of a boat used for diving purposes, to prevent the life line and hose connection of a diver's outfit fowling. Patent 1713446. Gabull Peterson.

COOKER—Having a vertically adjustable food supporter whereby the food may be held at any desired point above the cooker bottom, and wherein an even degree of heat will be transmitted, and the fuel consumption reduced. Patent 1712926. Tennie Lowe-Lile.

SALT-BATH FURNACE—Whereby the molten salt is kept at the desired temperature for hardening steel in a non-decarburizing condition, which consists in the introduction of an acid, non-volatile oxide, preferably silica, in contact with the salt. Patent 1713472. Axel G. E. Hultgren.

ORNAMENTAL BUILDING—A structure of conical form, having doors and windows near its base, and depicting an edible ice cream cone, with means for illuminating the exterior by projected lights to harmonize with the cone and colors of the ice cream. Patent 1713050. George H. Natzel and Frank E. Jackson.

SPRING ACTION FOR FIREARM HAMMERS—Capable of application to all types of firearms, when applied to automatic pistols, dispenses with the comparatively complicated spring action embodied in the grip, and in the heavier types permits the grip to be reduced in size. Patent 1711874. Archibald R. Brinkerhoff.

HOLDING RING FOR COMPACT PLATES—An L or Z shaped ring in cross section, for holding compact plates in position, the construction being such that projections from part of the ring act as yielding locking means for holding the compact plate in position. Patent 1714376. William G. Kendall.

SURFACE FINISHER—Including a finishing head to be slid back and forth over a floor or other surface being worked upon, and a hollow manipulating handle which constitutes a reservoir for the liquid used in the finishing operation. Patent 1714350. Harold de Jong.

FOLDING CHAIR—Having a back frame element with which a seat and supporting legs are foldably connected in such manner as to lie wholly within the confines of the back, and occupy a minimum of space in storage. Patent 1714323. Finn Simmons.

PACKING COVER—Made of rigid or semi-rigid material, in a completed or knock-down form ready for assembly for the protection of delicate parts and adjustments of a typewriter, while in the process of packing or in transit. Patent 1737724. James P. Ward.

CONTAINER—For powdered or granular material, having two relatively rotatable sections which permit the discharge of the contents when uncovered, without likelihood of the openings becoming clogged should the contents become moist. Patent 1714368. Arthur W. Hobson.

SOAP CHIPPER—Whereby a housewife may slice up into ribbon-like chips her favorite brand of soap instead of being obliged to use soap flakes of the brands usually sold on the market. Patent 1714413. John A. Woodward and Leo M. Greany.

SWAB HOLDER AND SWAB THEREFOR—Comprising a pair of forked extensions for receiving a tubular element and maintaining the same under tension, adapted for use in holding a tooth brush, a medical swab, or other purposes where such a handle may be applied. Patent 1713815. Joseph T. Berthelote.

Hardware and Tools

SHEARS—Embodying crossed blades having arms provided with finger loops and shoulders and edges so formed that they permit the normal cutting of hair but prevent pinching or cutting the ears or other parts of the head. Patent 1710456. Henry W. Latimer.

SPEED WRENCH—Having mechanism functioning by the action of inertia to automatically cause rotation of the stock to continue through an uncertain interval of time thereby greatly facilitating the labor of releasing tightly bound nuts. Patent 1710198. Emil Torgerson.

PIPE-BENDING TOOL—Which may be set on any size pipe up to and including three-fourths of an inch at any angle to a curve, whereby the bend is to be changed in form, is particularly adapted for electric conduits. Patent 1712414. Andrew B. Allen.

CAN PUNCH AND VENT—For punching a plurality of holes in the head of a can which may be used for pouring the contents from the can, and for venting the can, and sealing the openings when the can is not in use. Patent 1709514. Charles W. Bassett and Edna M Bassett.

COMBINATION DRILL AND COUNTERSINK—Comprising a drilling portion, a countersinking portion, and a stop, in one single-piece unit, so arranged that the unit may be economically manufactured, for use in the drilling of brake linings. Patent 1711012. Rudolph Brandt.

SCREW DRIVER ATTACHMENT—For preventing slippage between the screw driver and the screw, the attachment automatically giving way and freeing the screw as the screw is driven home, is readily applied to any standard screw driver. Patent 1712196. William A. Burger and Raymond B. Callahan.

SASH-CORD ANCHOR—In the form of a metal plate detachably secured to the inner face of the stile which enables the attachment to be made or the cord released without removing the sash or disturbing any part of the frame. Patent 1713422. Jacob A. Cohen.

WRENCH—Having the dual properties of a pipe wrench and a nut wrench and quickly adjustable means for the jaws in either use, the handle and jaws acting as a compound lever to cause the jaws to grip any object. Patent 1713038. Amos K. Ersland.

PAINTING AND DECORATING TOOL—Or hand machine adapted for striping, stenciling and straight surface painting, the tool including a fluid reservoir and novel paint feeding and applying means, and may be readily used by those unskilled in the work. Patent 1713750. Allen H. Dow.

CAN OPENER—Having a supporting plate upon which a can may rest, and a standard carrying a blade for cutting the can top, and means for rolling the cut edge so that it will be continuously smooth. Patent 1713823. Henry J. Edlund.

Heating and Lighting

FIREPLACE—The hearth of which is raised a slight distance above a floor, a well depressed below the level of the hearth and air ducts communicating with the well for deflecting practically all the heat into the room. Patent 1711099. Samuel A. Ford and Richard Waldie.

FURNACE UTILIZING FORCED DRAFT—So arranged as to cause a constant pressure of steam in the boiler, the steam pressure controlling the draft passing through the grate, and the draft controlling the fuel supply to the combustion chamber. Patent 1714432. Elmer A. McArthur.

Machines and Mechanical Devices

MECHANICAL MOVEMENT—A vertically reciprocating float readily raised by the waves and falling by gravity, and means whereby the rising and falling will be guided between racks thus generating power on both upward and downward strokes. Patent 1711103. Richard B. Smith.

REFRIGERATING SYSTEM—Comprising means for circulating a refrigerant fluid, whereby the refrigeration of the circulated medium is stopped whenever the pressure of the circulated medium increases or decreases between certain limits, thereby preventing the freezing up of the coolers. The inventor has been granted two patents, 1712567 and 1712568. Richard W. Kritzer.

TEXTILE-FINISHING MACHINE—Which operates to smooth the fabric and impart a high luster and natural sheen on both sides of the cloth during a single running, and whereby a uniform pull is exerted in feeding the cloth through the machine. Patent 1712308. Frederick W. P. Rose and Christian Werner.

WOODWORKING MACHINE—Capable of being readily converted into a rotary disk saw machine, a reciprocating scroll saw machine, and a wood turning lathe, also functioning as a grinding wheel, buffer, polishing wheel and drill. Patent 1711077. Henri C. Babize.

GLASS-SERVING APPARATUS—For use in connection with automatic bottle making machines, for flowing a molten slug of glass from the furnace into a container in such manner that the hot end will be subsequently arranged adjacent the moulding form. Patent 1712327. Homer Brooke.

POWER-MULTIPLYING MECHANISM—Which provides a simple means for transmitting power from one point to another through levers, and whereby a comparatively long stroke is translated into a power thrust of short strokes with a minimum loss in transmission. Patent 1712444. Douglas F. Maltby.

SOLDERING MACHINE—For soldering the corners of metal doors or similar articles, a universally adjustable work holder being provided to which the door is secured, and the corners immersed first in an acid pot and then in a solder pot. Patent 1712443. Louis Liebman.

ASPIRATING DEVICE—Comprising a closed casing formed of telescoped tubular sections detachably joined in concentric relation providing a fluid pressure receiving chamber housing an aspirating tube as applicable to so called "vacuum cleaners." Patent 1712425. Henry S. Earnest.

SOUND-REPRODUCING AND PICTURE-EXHIBITING APPARATUS—Whereby the microphone of a radio circuit and an amplifying horn are employed for permitting sound to be distributed simultaneously with the act of projecting pictures of objects or scenes upon an exhibiting screen. Patent 1710994. Albert T. Marshall.

AUTOMATIC STOP FOR TABULATING MACHINES—Which can be attached to any standard type of machine and set to permit tabulation of any desired number of lines and then automatically stop, the operation may be repeated as often as desired. Patent 1712901. Robert E. Paris.

PROPELLER FOR SURFACE WATER CRAFT—Whereby oppositely driven propellers are arranged side by side, each mounted in such manner as to dispose only the lower part of each blade in the water, when the boat attains its maximum speed. Patent 1713448. William J. Roe.

SOUND-REPRODUCING MACHINE—Comprising a plurality of record disc carrying tables, a continuously driven shaft and a pair of auxiliary shafts, for automatically changing the discs whereby a continuity of reproductions of a series of records may be obtained. Patent 1713481. Luigi Robimarga.

STAGE LIFT FLOWING DEVICE—A combination differential and velocity fluid pressure control device or valve, designed to open and close by the velocity and pressure of a liquid column to control the flow of liquid. Patent 1712418. Alexander Boynton.

GUARD FOR PAPER-WINDING MACHINES—Of the double drum type, which automatically conforms to the size of the roll as it is being wound, and when wound may be swung to an out-of-the-way position for the removal of the finished roll, and replacement of a new core. Patent 1713382. John C. Hammel and William O. Dickinson.

GROMMET-MAKING MACHINE—Wherein the strands of rope are fed into the machine by hand, and held in place while applied to a mandrel, and acted on in such manner that a grommet will be formed thicker than the strands used. Patent 1714339. William A. Young and Roland L. Ankener.

PAINT MIXER—Comprising means for detachably supporting in a rotatable vertical operative position upon a container, a paddle formed from bent wire loops, for quickly remixing ready-mixed paint, which by reason of standing has settled. Patent 1714436. Harold S. Rambo.

Medical and Surgical Devices

DENTAL TOOL—A power driven reciprocating file, which is particularly helpful for cutting down the abutting faces of adjacent teeth, and smoothing off fillings or preparing a tooth for filling. Patent 1712469. Willard B. Force.

Prime Movers and Their Accessories

THERMOSTATIC VALVE CONTROL—For controlling water flow, especially adapted to be used in connection with a motor and a radiator for automatically closing the circuit of water, whereby the motor may be warmed up more readily. Patent 1711901. Adolph O. Nelson.

COMBINED STEAM ELECTRIC DRIVE FOR GENERATOR SETS—An arrangement of steam and electric power drive providing full and flexible accommodation to generator load and shaft torque with a balanced distribution of the load on the shaft. Patent 1714449. Ralph E. Royse.

SAFETY DASHPOT—For use in conjunction with centrifugal governors now in common use on steam engines, turbines and electric generators, for providing a proper damping effect while permitting quick movement under unusual circumstances. Patent 1714431. Olovg Lissen.

Railways and Their Accessories

CROSSING GATE—Including a fixed frame structure, and two units arranged at the crossing approaches and operated by the train to close the gates while the train is passing, and open the gates when the train has passed. Patent 1712441. Louis Lamagna and Albino Botta.

RAILWAY TIE AND RAIL SEAT—A concrete tie adequately re-inforced at the points of greatest strain, and in addition having a base forming a seat resisting upward displacement and offering compensation and adjustment for wear both in rail tread and seat. Patent 1713454. John E. Springer.

Pertaining to Recreation

TOY PARACHUTE—In the nature of a ball composed of sections held together for a predetermined length of time by suction, but separating after the ball is thrown in the air, and forming a parachute which will slowly descend. Patent 1713432. Theodore G. Griggs.

DANCING TOY—Doll figures supported in such relation to the rotary turn table of a phonograph that the operation of the phonograph will produce motion simulating dancing in consonance with the music. Patent 1713430. Isaac W. Furman.

EXERCISE BAR—A strong durable bar, which may be used as an ordinary gymnastic wand except that it may be extended and collapsed during exercising movements, or the members locked at any given length, forming a rigid bar. Patent 1714391. Robert B. McWhirter.

Pertaining to Vehicles

SIGNAL—An automatic electrically operated signal whereby the driver of a motor vehicle may readily ascertain whether or not the usual tail and signal lights are functioning. Patent 1712395. Alexander M. Miller.

AUTOMOBILE LIGHT INDICATOR—Particularly adapted for association with the lighting circuits, to positively indicate to the operator whether the head and tail lights are illuminated when intended so that should any one light be extinguished it will be indicated to the driver. Patent 1713051. John A. Oya.

APPARATUS FOR USE IN CLEANING AND POLISHING AUTOMOBILES—By which the performance of the several operations necessary in cleaning and polishing an automobile both interiorly and exteriorly is greatly facilitated, and on a relatively small area of ground. Patent 1713014. Louis J. Wilde and Bee K. Gillespie.

SAFETY DEVICE FOR AUTOMOBILES—Which swings a guard member, arranged in front of the bumper, to push a pedestrian out of the way when an accident is imminent and automatically applies the brake, the operating lever being actuated from the driver's seat. Patent 1713403. Walter Sniatowski.

DUST GUARD—Or mud guard, for automobiles or other vehicles, constructed of resilient material throughout, and of such consistency that it will yield and then return to form after an appreciable blow. Patent 1713405. Arthur V. Stansfeld.

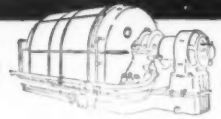
CAMPING OUTFIT FOR AUTOMOBILISTS—Constituting articles such as a table, stools, and storage receptacles for food, all of which may be nested as a single unit and carried trunk-like on an appropriate and quickly accessible part of an automobile. Patent 1712213. Horace W. Janicke.

TRUCK—A two wheeled truck adapted to support the forward end of a two wheeled cart, capable of a wide range of utility, but particularly forming a supporting and traction means for the conventional Cuban cane cart. Patent 1714383. Ricardo Leon.

JACKING APPARATUS FOR TRAILERS—Which will elevate the trailer to disconnect the coupling with the tractor, and will support said trailer in elevated position while it is being loaded or unloaded, thereby relieving the tractor for other work. Patent 1715236. John A. Higgins.

VALVE—For pneumatic tires, wherein the seating member is held against the valve seat by a screw connection with the valve casing, instead of the usual spring actuated seating member. Patent 1713889. Walter H. Criswell and Leslie W. Bond.

Many Well-Known Men Have Helped To Prepare These ELECTRICAL COURSES



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